Technology Enriched Administrators

Modules for Guiding the Integration of Educational Technology in Education

This introductory material is based on an article by Schoeny, Heaton, and Washington titled "Perceptions and Educational Technology Needs of School Administrators", Presented at Site99, San Antonio, Texas.

1. Introduction

While increased attention has been directed to the need for improved technology training for teachers has seen increased attention in recent years, the training needs of pre-service and in-service school administrators has received minimal attention. Telem (1991) suggests that issues related to instructional technology development for school administrators have been ignored for the most part, with limited attention "in the literature, at scientific meetings, and among special interest groups in professional associations in education" (p. 595). Despite this lack of attention and training, administrators are still faced with increased responsibilities for infusing technology into the schools. "The importance of technology and computers has increased tremendously in the last few years as superintendents are pressured to purchase the latest equipment, hire computer coordinators, train teachers to use the equipment, and connect everything to the network" (Sharp & Walter, 1997, p.8). If administrators are to successfully fulfill these tasks, instructional technology must "become an integral part of the curriculum of universities and other institutions preparing school administrators" (Telem, 1991, p. 605). With training there is the possibility of "using [Instructional Technology] as an aggressive educational leadership tool and a proactive management tool" (p. 605). Unfortunately, many of the technology courses that have been offered for school administrators have emphasized skills-based training. While some of these courses have been successful, many have failed to provide the comprehensive experience that administrators need.

2. Needs and Perceptions

Studies have indicated that knowledgeable school administrators contribute significantly to the proper integration of technology (Beach & Vacca, 1985). Technology training for instructional leaders is vital (Bruder, 1990) to the successful infusion of technology into the daily instructional and administrative routine of our public schools.

> Principals…must have a solid 'base of knowledge' to draw on, whether they're setting budgets and standards for their schools, implementing system-wide technology plans or, just trying to keep pace with staff and students (Rockman & Sloan, 1993, p. 2).

Through informal discussions with fellow administrators, Brooks (1997) found that the majority were concerned with the acquisition of technology rather than what would take place after the technology arrived. She suggests that principals need the knowledge to make more informed budgeting decisions that include a stronger emphasis on providing professional development opportunities for teachers. Staff development has been identified by many studies as a key component to the successful implementation of technology (Costello, 1997). Brooks

believes that both teachers and administrators need to realize that the successful implementation of technology into instruction will require changes in instructional approaches as teachers become facilitators of learning rather than distributors of knowledge.

Administrators, as instructional leaders, "need to develop the understanding necessary to guide their instructional technology programs and to have the hands-on experiences that training on administrative uses of technology provides" (Beaver, 1991, p. 1). Beaver used mailed surveys to gather information from building, district, and state-level administrators regarding their technology competence. While 70 percent of respondents indicated the importance of computer use to their success on the job, 73 percent indicated having little or no technological competence. Additionally, 77 percent reported that they had not participated in technology training. These results influenced his recommendations for elements to be included in a technology course for administrators. Beaver suggests practical applications of productivity tools, group discussions of relevant technology issues, and individual and group projects that allow participants to develop skills that meet their needs and interests.

> Without the hands-on experience, discussions become remote, second-hand experiences. Without the discussions, the hands-on experiences degenerate to software training workshops. Without the discussions and hands-on workshops, the project presentations become 'Show-And-Tell' sessions. Together, the three components provide a solid foundation for an administrative computer leadership capable of guiding us steadily into the next decade (p.13).

Beach and Vacca (1985) suggest that public level administrators, as technology leaders, will deal with "effective methods of implementing micro-computer-based instructional programs" (p. 31). The purpose of their study was to identify the role of administrators in the implementation of technology in high schools identified by the Southern Association of Colleges and Schools as using computer technology. High school principals in six Southern states responded to a demographic questionnaire and *Leader Effectiveness and Adaptability Description* survey. The demographic questions sought to determine numbers and instructional use of computers, technology planning and management, professional development for teachers, and the administrators' technological competence. Beach and Vacca found that administrators' responses to items regarding the "functional utility" of computers in education were distributed among choices of "limited", "technological fad", "vital innovation", "part of program", and "no response" (p. 36). The majority of responses indicated that computers were an important part of the school program. The *Leader Effectiveness and Adaptability Description* was used to measure administrators' leadership style. Most respondents were categorized as "High Task-High Relationship," which implies a flexible and adaptable leadership style. The authors believe that "successful implementation varies directly with the adaptability of the administrator" (p.44).

The *Technology Survey for Principals,* developed by Heaton and Washington (1998) was distributed to administrative interns as a pilot test of the instrument. The instrument was developed to determine relevant issues related to technology policy, the principal's role as a technology leader, and personal technological competence. Participants were asked to rank the relevant issues in order of their importance. Additional items were included to identify specific issues and skills related to the three ranked items. Half of the respondents ranked personal skills as most important, however, 93 percent of participants ranked learning to be an instructional leader as either first or second. The development and implementation of a technology plan that includes strong support for technology training related to helping teachers meet state technology

standards were among the highest rated issues. Technology training for pre-service administrators should emphasize the importance of becoming a technology leader. Course content should provide an awareness of ways to encourage instructional and administrative technology use, hardware and software requirements needed to support uses of technology, and ways to support teacher participation in technology training. Technology issues related to the development and implementation of a school technology plan should be discussed throughout the course. The interest in developing personal skills should be addressed through completion of context-based projects that allow administrators to develop skills relevant to their daily routine.

3. Comparison of Studies

The purpose, results, and recommendations discussed in section two above are outlined in Table 1.

Purpose	Results	Recommendations
To look at the administrator's role in technology planning Based on informal discussions with fellow administrators Brooks (1997)	• Principals often focus on acquisition of technology • Principals have little knowledge of the technology purchased	Principals need to: • Make informed budgeting decisions • Recognize the ability of technology to change/improve education • Play "an active role in the planning and implementation of technology" (p. 30) • Create professional development opportunities for teachers
To determine the technology competence of administrators and make recommendations regarding technology course content 59 of 75 administrators in West Central Florida completed a 36-item mailed survey Beaver (1991)	Participants reported: • Little or no technological competence • Competent computer use as important to success on the job • Little or no technology training	Administrators need: • Practical applications of productivity tools • Group discussions of relevant technology issues • Individual and group projects to develop skills that meet their needs and interests
To identify the role of administrators in the implementation of technology 231 of 309 high school principals in six Southern states with an identified interest in integrating technology responded to a demographic questionnaire and *Leader Effectiveness and Adaptability Description* survey Beach & Vacca (1985)	• Computer use is an important part of the school program • Principals ranked high on the "High Task-High Relationship" leadership style • 84% of principals rated themselves as novice computer users	Administrators should be flexible and adaptable in order to successfully implement educational technology

| To determine relevant issues related to technology policy, the principal's role as a technology leader, and personal technological competence

14 of 16 administrative interns enrolled in a technology course at the University of Virginia completed the *Technology Survey for Principals*

Heaton & Washington (1998) | • 7 of 14 (50%) ranked personal skills as most important
• 6 of 14 and 7of 14 (93%) ranked learning to be an instructional leader as first or second respectively
Among the topics rated as most relevant to the administrator's role:
• Development and implementation of the school technology plan
• Ways to support technology training for teachers
• Funding and selection of hardware and software
• Supporting instructional applications of technology | Administrators need training that includes:
• Ways of becoming an instructional leader
• Context based skills development
• Discussions of relevant technology issues |

4. Technology Standards for Students, Teachers, and Administrators

In June 1995, the Virginia Board of Education approved Standards of Learning (SOL) in four core content areas - mathematics, science, English, and history and the social sciences. The standards in the core content areas include benchmarks describing the technology skills and knowledge students should acquire by the end of the fifth and eighth grades. Minimum competencies at the end of grade five include:
- knowledge of technology terminology
- keyboarding skills
- operating peripheral devices
- accessing information from electronic databases
- integrating graphics in word processed documents
- creating simple spreadsheets and databases

While the standards also require students to be able to "apply technologies to strategies for problem-solving and critical thinking," (http://www.pen.k12.va.us/go/Sols/home.shtml) they are strongly skills-based, rather than content-based competencies. By the end of the eighth grade, students are required to demonstrate the following competencies:
- composing and editing a multi-page document
- communicating with spreadsheets by entering data and setting up formulas
- analyzing data and creating graphs or charts to visually represent data
- communicating with databases by defining fields and entering data, sorting and producing reports in various forms
- using advanced publishing software, graphics programs, and scanners to produce page layouts
- integrating databases, graphics, and spreadsheets into word-processed documents

Additionally, students should be proficient in communicating via e-mail and creating Web pages. In the spring of 1997, the state began administering stand-alone technology tests corresponding to the standards.

In September 1995, the Board of Education requested that ABTEL (Advisory Board on Teacher Education and Licensure) "examine the issue of technology proficiencies as a requirement for licensure for instructional personnel." (http://www.pen.k12.va.us/go/VDOE/Compliance/TeacherED/tech.html). Instructional personnel refers to all school personnel required to hold a license issued by the Virginia Board of Education for instructional purposes. A task force was organized to make recommendations to ABTEL regarding technology proficiency for licensure. The adopted recommendations are referred to by the Board of Education as "Technology Standards for Instructional Personnel." Local school divisions and institutions of higher education are expected to develop plans to implement and assess these standards by December 1998.

Technology Standards for Instructional Personnel require teachers to demonstrate competency in the following areas:

- operating a variety of computer systems and accompanying peripheral devices, utilizing instructional, application tools, productivity, and courseware software programs, and troubleshooting general hardware and software problems
- applying knowledge of educational computing and technology terminology
- using software tools to assist with administrative tasks, development of instructional materials, correspond with students and parents
- using telecommunications software
- incorporating word processing, spreadsheet, or database software in instruction
- using presentation and/or authoring software
- using computers, modems, networks, printers, large-group presentation devices, scanners, digital cameras, camcorders, video cassette recorders, optical disc players, etc.
- using educational technologies for data collection, information management, problem-solving, decision making, communications, and presentations within the curriculum.
- using multimedia, hypermedia, and telecommunications software to support individual and/or small group instruction as teaching assignments dictate
- abiding by copyright laws, practice responsible uses of technology.

In the fall of 1998, the Southern Regional Education Board proposed "Technology Standards for School Administrators." Several key areas of technology competence were identified as being crucial to administrators' ability to take a leadership role in the creation of technology related programs. The proposed standards include the administrators' ability to:

- understand the elements and characteristics of long-range planning for the use of current and emerging technology
- demonstrate ability to analyze and react to technology issues, concepts, and proposals
- possess a "big picture" vision of technology in education and schools
- use technology to efficiently communicate with stakeholders
- use technology to collect and analyze data and other information to improve decision making and other management functions
- understand how current and available technologies can be effectively integrated into all aspects of the teaching and learning process
- understand the legal and ethical issues related to technology licensing and usage.

5. Recommendations Regarding Administrators' Technology Needs

The suggestions provided by the review of research and the technology standards discussed in section three of this paper are intended to guide the development of general recommendations for technology training for administrators. The recommendations are divided into three main sections including: understanding technology management issues, the impact of technology on educational change, and administrative uses of technology; however, they are not intended to be an exhaustive list of administrators' technology needs. Highlights of each section are as follows:

- Understanding technology management issues
  - providing proper funding for training and support
  - managing software and hardware acquisition and upgrades
  - technology planning
  - budgeting for technology training and support
  - knowing technology standards for students and instructional personnel
  - participating in the development and implementation of the school/district technology plan
  - developing personal and staff development programs
  - comprehending ethical and legal issues related to technology use
- Impact of technology on educational change
  - create a supportive environment for change
  - support changes in instruction that encourage teachers to become facilitators of learning
  - learn ways to encourage students to take a more active role in their own learning
  - develop long-range plans that adapt the vision/mission of the school to include the infusion of technology across the curriculum
- Administrative uses of technology
  - learning ways to communicate with students, teachers, and parents
  - analyzing and organizing data to make informed decisions
  - encouraging teachers' administrative use of technology
  - utilizing Internet resources for personal professional development
  - staying abreast of current literature in instructional technology and related fields

"If we expect our administrators to provide the vision and understanding needed to guide the development of instructional computing programs, we must encourage them to increase their computer competence" (Beaver, 1991, p.4). Training for administrators must include a comprehensive experience with practical applications as well as discussions of pertinent issues related to the implementation and support of technology. Such training will encourage maximum integration of technology into the daily performance of administrators.

6. References

Beach, R. H., & Vacca, A. M. (1985). Administrative variables and microcomputer implementation: a survey of high school principals. *Computers in the Schools*, 2(1), 31-46.

Beaver, J. F. (1991). Sharing the vision, power, and experience: advocating technologically competent administrators. Paper presented at the Annual Meeting of the Northeastern Educational Research Association. Ellenville, NY. ERIC ED 340 130

Brooks, S. (1997). Are you leading the way? *Technology and Learning, 18*(2), p. 30.

Bruder, I. (1990). Restructuring the Kitsap Experience. *Electronic Learning, 10*(2), pp. 16-19.

Costello, R. (1997). The Leadership Role in Making the Technology Connection. *T.H.E. Journal*, *25*(4), pp. 58-62.

Rockman, S., & Sloan, K.R. (1993*). A Program that Works: Indiana's Principals' Technology Leadership Training Program.* Indiana State Department of Education. ERIC ED 368 350

Sharp, W. L., & Walter, J. K. (1997). *School Administrators' Perceptions of Trends, Issues, and Responsibilities Relating to the Modern Educational Climate*. Paper presented at the Annual Meeting of the Mid-Western Educational Research Association: Chicago, Illinois. ERIC ED 412 653

Virginia Department of Education. Standards of Learning. [online] Available: http://www.pen.k12.va.us/go/Sols/home.shtml (12/08/98).

Virginia Department of Education. Technology Standards for Instructional Personnel. [online] Available: http://www.pen.k12.va.us/go/VDOE/Compliance/TeacherED/tech.html). (12/08/98).

Module 1: Overview

Overview

- **Before We Begin…**
- **Understanding and Managing Technology Rich Settings**
- **The Role of Technology in Education**
- **The Role of Technology in Administration**
- **Staying Ahead of the Game: Setting Your Course**
- **Technology for Special Needs**
- **Observation and Integration**

This module provides a general overview of all the modules comprising the curriculum. Think of it as a tour guide to the rest of the modules.

Overview (Module 1)

This curriculum was developed to provide administrators with a starting point for understanding the complex and seemingly overwhelming task of integrating technology into the educational process. There are eight modules in the package, arranged in a convenient order. However, the users are free to follow their interests and cover the modules in any order.

Focus
The primary focus of this package is to address the issues, tasks, and policy matters that must be resolved by administrators if technology integration is to be successful in the schools.

Information
References and additional learning resources will be given for those who would like to get more details regarding specific technology issues and components.

Mindset
It is important for the users to spend a reasonable time with the Before We Begin module as this provides the basis for understanding and viewing the entire process of technology integration in the schools and procedures to measure the success of these endeavors. Many efforts to integrate technology into the schools have fallen short of expectations because the proper goals for educational integration were not established and understood by the responsible parties.

9

Additions

In addition to the modules, there will be case scenarios, questionnaires, and exercises that will be used to enhance learning.

Before We Begin… (Module 2)

In this module, it is critical to comprehend the process of change required for the successful integration of technology into the learning process. An important consideration for all technology plans involves the understanding of the overall picture; that is, how technology works and develops, as well as appropriate uses of technology. An overall view or gestalt is offered that maps out the general direction or lay of the land. The highlights of this module include: how we view activities involving change, the background, overview, and fundamental information, looking at problems in a different context, and how to successfully implement a technology plan. The general steps required for the successful implementation of technology into the educational process are outlined.

Understanding and Managing Technology Rich Settings (Module 3)

In this module, information on building design (physical plant) related to learning and technology are covered. Knowledge and understanding of issues related to infrastructure, hardware, software, budgeting, personnel development, and security issues are essential to the success of a technology plan. Material in this section is provided to help administrators to develop the appropriate decision-making skills in the technology integration arena.

The Role of Technology in Education (Module 4)

In this module, the role of technology is presented relative to the changes that need to occur to ensure successful integration of technology into the curriculum. Management of change is a key function of technological leadership. Technology can change how specific environments relate to each other and how the student functions in a specific environment. Change to support learning needs to be addressed in the home, school, classroom, and community. It is more realistic to present information regarding changes in the learning process than to try and predict the specific role that rapidly changing technology will play in the educational process.

The Role of Technology in Administration (Module 5)

In this module, issues related to data collection and management are presented. Uses of the data to make informed decisions are stressed. Software options for scheduling and reporting are covered. Technology can support the administrative functioning of schools in a variety of ways including: scheduling, data collection, communication with parents, communication with teachers, and communication with local community members. Technology's role in supporting administrators and the role of the Virginia State Department of Education (VDOE) in technology implementation are discussed in this module.

Staying Ahead of the Game: Setting Your Own Course (Module 6)

In this module, a presentation of current and emerging technologies is given. Guidelines for knowing when technology is appropriate and when it is not appropriate are considered. Strategies

to help the informed administrator choose an appropriate course for technology implementation are suggested. It is important to be able to make those choices without being controlled by hardware and software advances and changes. Finding ways to allow traditional educational values and technology to complement each other are discussed. In addition, how technology can enhance communication, how to involve industry in schools, and how to involve the community in education are addressed.

Technology for Special Needs (Module 7)

In this module, information related to learners with special needs is presented with an emphasis on the value of technology to provide an enhanced interface for learning. The module includes information for both learners with disabilities and learners that can benefit from the special applications, which can be developed using the unique benefits of technology. Some of these unique features include, time displacement, simulations, and multimedia presentation for improved visualization.

Observation and Integration: What Technology Leaders Need to Know (Module 8)

In this module, information is provided to assist in the important observation of the technology integration process in the classroom and to informally evaluate the level of technology use in the school/division. Material is provided to assist in understanding the process of implementation of technology in the content areas as well as many examples of material to share with colleagues.

Study Guide and Resources for Module 1
Questions to Consider:

Where is my school/district in the technology planning process?
     _____ pre-historic times
     _____ somewhat progressive
     _____ advanced planning
     _____ ready for the new millennium

     Comments and questions:

What do I think are my areas of weakness in technology planning?
     For example:
     _____ "fear" of technology
     _____ lack of interest
     _____ lack of knowledge
     _____ lack of resources (funding, training, support)
     _____ not convinced of it's value in education

Comments and questions:

What do I want to learn first when using this curriculum?
   _____ how to initiate technology planning
   _____ how to initiate technology plan
   _____ how to implement technology plan
   _____ what do I need to know
   _____ what resources do I need

   Comments and questions:

How do I use this program?
   _____ individually guided
   _____ skip around to areas of interest
   _____ step by step in order of presentation

   Comments and questions:

What do I hope to gain by integrating technology into my school/division?
   _____ my students and faculty will be ready for the future
   _____ I will be up to speed in technology
   _____ my community will support education and take pride in their schools
   _____ business and community members will share in the development and use of
     technology facilities in the schools
   _____ time for learning will be increased beyond "seat time"

   Comments and questions:

Resources and Supplementary Materials:

The following URL's take you to sites that provide comprehensive information regarding the integration of technology into the educational process:

Learning Through Technology: A Planning and Implementation Guide
http://www.ncrel.org/tandl/homepg.html

Milken Exchange on Education Technology
http://www.milkenexchange.org

National Center for Technology Planning
http://www.nctp.com

Assiniboine South School Division Web page for Administration
http://www.assd.winnepeg.mb.ca/main/admin.htm

Module 2: Before We Begin…

Before We Begin...

- **What is the Playing Field?**
- **How We View Activities Involving Change is Very Important**
- **Background, Overview, and Fundamental Information**
- **Looking at Problems in a Different Context**
- **Challenges to Technology Integration in the School**
- **Technological Barriers that Can Be Encountered**
- **Areas of Successful Diffusion in the Schools**

In this module, it is critical to comprehend the process of change required for the successful integration of technology into the learning process. An important consideration for all technology plans involves the understanding of the overall picture; that is how technology works, and develops, as well as appropriate uses of technology. An overall view or gestalt is offered which maps out the general direction or lay of the land.

The highlights of this module include: how we view activities involving change, the background, overview, and fundamental information, looking at problems in a different context, and how to successfully implement a technology plan. The general steps required for the successful implementation of technology into the educational process are outlined.

It is necessary to understand the educational changes required for the implementation of technology into the educational process. Technology should be used to support educational goals and to enhance the learning process not simply as another subject to learn.

I. What is the Playing Field?

An important consideration for successful implementation of all technology plans is to understand the overall picture of how technology works and develops as well as realizing the appropriate uses of technology.

What are the viewpoints regarding technology integration?

Knowing the differing viewpoints related to the implementation of educational technology is essential to realizing where different people are in the process and what options are available for use in implementation. It is critical to be sure that all parties understand the same problems, consider the same issues, and are aware of the same solutions.

What is the purpose of educational technology?
The purpose of educational technology is to support and foster learning in schools. Currently, there is emphasis on infusing technology in classrooms; however, what is actually done with the technology to foster learning is more important. Administrators should be conversant with the issues surrounding technology integration in the schools while remaining mindful of the mission/goal of schools to foster learning.

What are the potential applications?
Technology in education has several potential applications that include:

- Administrative tasks (record keeping, budget analysis, and communication)

- Electronic communication that may expand the possibilities for ways to exchange ideas and information.

- Technology applications for learning which may include graphic programs, Web development, computer simulations, and learning software.

- Project-based learning that incorporates elements of electronic communication, Web-based research and development, and CD-ROM technology.

How will individuals be involved?
Technology is not different from other tools or methods used in education. Technology integration needs to be viewed as a process of educational change involving people at all levels of the process.

II. How We View Activities Involving Change is Very Important

The change process involved in technology is similar to change in any area of educational endeavor. It is important to remember the following key ideas:

1. Individual Perspective. How individuals view change to relate to their perspective, experience, and individual personality.

2. Positive Outlook. The process of technology integration may have lengthy delays and some frustration. It is helpful to remain positive and view change as an ongoing process where even small steps can be measured as progress.

3. Flexibility. The process may occur in a stop and start mode which could be frustrating if users are rigid. Success is dependent upon flexibility and a willingness to try new things, and new ways of doing things.

4. Various Viewpoints. Communication with people is important to the change process. It is helpful to realize that different people may have differing views on how to work with technology most effectively.

III. Background, Overview, and Fundamental Information Needed for Understanding

The history of technology in education mirrors the development of technology in society as a whole. As technology has become more powerful and inexpensive, it has become more prevalent in all areas of life.

The appearance of personal computers in the mid-1970s was a big boost for the use of computers in education. The addition of microcomputers to the average classroom over the next decade ushered in a period of computer literacy that emphasized programming skills. This effectively added a new area to the school curriculum.

Since the late 1980s, there has been a shift toward computer competence that involves placing more emphasis on knowledge and understanding of computer technology and applications. This came about because of new authoring systems permitting instructors to develop materials and the Graphical User Interface (GUI). The newly developed multimedia capabilities made it easier to develop and present materials in the classroom, if the teacher had time.

In the 1990s there was a trend to use the computer primarily as a means for enhancing education. People who support this approach pushed for the integration of computers in the classroom so they became an integral part of everyday education, similar to the chalkboard or textbooks. A recent development to be embraced by the educational community is the use of hypermedia. The vast amount of information that is available through hypermedia environments like the World Wide Web (WWW) provides for incredibly powerful tools for learning.

Technology Fundamentals
Some things to keep in mind when implementing a technology program:

1. *Different setups will accomplish different goals*. This relates to the importance of knowing what you want to accomplish educationally via technology before you begin purchasing it.

2. *Hardware should have the capacity for meeting critical needs for at least two years*. This is a reminder that technology is rapidly changing, and it is important to identify and think about your current and future needs.

3. *Standardization is desirable whenever it can be accomplished in a reasonable way*.

4. *Knowledgeable users are critical*. A technology plan is only as good as the people implementing it.

5. *Appropriate training is essential.* This is the single most important item to remember. Without training, technology is expensive window dressing.

6. *Equity access is critical to the success of technology in the classroom.* For example, some students may have Internet access at home while others have no computers at home. This may affect the quality of papers turned in unless consideration is given to how all students can have access to a computer for homework.

IV. Looking at Problems in a Different Context is Important.

The success of a technology implementation plan should be judged by its effect it has on teaching and learning. Several studies warn against the use of technology simply as a tool to support instructional procedures because it impedes progress and fails to accommodate the full impact of technology integration. What some advocates propose is a synthesis of tools (technology) and pedagogy that results in teaching practices that would not be possible without both elements.

The Modern Technology Paradox

The paradox is you must spend time to save time. Learning to apply the technology appropriately requires a substantial time commitment. This time commitment is related not only to initial skill acquisition but includes becoming comfortable with the application of the technology. The paradox comes from the fact that this initial investment will lead to greater efficiency and less time will be required for many of the present educational activities.

Trained versus Untrained Use

In a study of exemplary computer-using teachers, Becker (1994) found that such teachers are more likely to be present in environments where computers are used for consequential activities. Specifically, the idea is that activities involving technology need to be relevant and meaningful to the learner. This is the concept of technology as a tool for learning and helps to create a learning context that would not be available without technology.

Pedagogical Consideration Before Technology Literacy

This is the concept that technology is a tool for learning and aiding educational goals. When implementing a technology plan, remember to begin with educational goals and develop the technology to support those goals. For example, you could begin with focusing on inquiry-based learning leading to a need for access to the World Wide Web (WWW) or multimedia computers.

V. Key Challenges to Technology Integration in the Schools.

The easiest way for officials to address the issue of technology integration in the schools is to purchase those technologies that people feel are necessary and to place them in classrooms. Though common, this type of effort is ultimately not successful because it assumes that technology can create change. In reality it is the pedagogy and the human element using the technology that are responsible for the change. Also, the learner is a key player in the success of

this plan. Successful integration of technology efforts include the recognition that changes in attitude and behavior by the teacher and students are necessary. The planning effort to integrate technology needs to be cognizant of how these changes in the learning process within schools can be facilitated.

Universal Need for Staff Training and Development
Now that computer technology is relatively inexpensive and its presence in classrooms is accepted, it is vital that divisions develop a workforce of teachers who are able to use the hardware and software effectively in education. Teachers must learn how to use the technology to teach. At the school level, administrators must assess the technological capability of their teachers and use that information to formulate a training agenda that will facilitate effective use of technology in teaching.

Release Time
A typical teacher's day is filled with lesson planning, grading student work, attending meetings, and teaching their classes. In addition, increased attention must be given to the Standards of Learning and how to effectively teach them. To introduce technology into this environment, administrators should consider the overall workload of their teaching staffs. The most immediate way to help alleviate concerns about overloading teachers is to provide ample release time for training in the use of technology in teaching. Remember that there is a learning curve with the introduction of technology, and it takes time and practice to gain mastery of these skills. Supportive administrators will help to accomplish the necessary changes without creating resentment among the teaching staff.

Overcoming Inertia
Given all the responsibilities and demands on teachers, it is easy to understand how inertia towards technology can occur. Administrators may want to set small goals to be met and provide regular assessment of progress to technology integration goals as a way to motivate change.

Cooperating with Parents, Teachers, Schools, and Communities
Schools are a community entity and resource. Schools and administrators need to maintain an awareness of educational trends within their communities. Administrators also need to work with parents, teachers, other schools and community members to create and implement an educational process that meets the needs and desires of stakeholders.

Identifying and Establishing Continuing Financial Resources
Caution: Currently, there is substantial funding for technology, but it would be reduced in the future. Administrators should consider past funding issues with respect to education and plan for alternative funding sources to support technology should the need arise.

VI. Technological Barriers That Can Be Encountered

The technological barriers that can be encountered reflect barriers to any change process in schools; however, technology does present some unique difficulties because it is rapidly changing.

Barriers
The following are barriers:

1. *Individual resistance to change*. This is a common barrier in any change process and can be overcome through communication and support for the people involved in the change.

2. *Expense of initial setup and development*. This includes the need to budget for upgrades and staff training time.

3. *Too many choices*. This can be overwhelming with technology and can confuse selection of tools and materials. This may also lead to inertia because of lack of confidence that what is being chosen will work in the classroom or support educational goals.

4. *Working with a shifting target in a changing playing field.* This relates to the continual rapid developments in the field of technology that create a changing environment.

VII. Areas of Successful Diffusion in the Schools

The diffusion of technology throughout a school system often begins with the Library Media Center. In addition, technology has become prevalent in administrative functions that help to track student and budget data. These areas where technology has become commonplace can serve as a foundation for technology integration across all levels of districts and schools.

Areas of successful diffusion have included:

1. *Library Media Centers***.** In the past few years, libraries and media centers have been wired for electronic resources. In many schools, the librarian is the onsite coach or support for teachers using technology. Librarians have special training in searching the Internet for resources, which serves as a helpful function to teachers integrating Internet resources into classrooms.

2. *Online Resources***.** An increasing number of schools are being wired for the Internet. Online resources expand the ability of students and teachers to locate information, explore new areas of knowledge, and share experience with others on the Internet.

3. *Administrative Data Tracking*. Many software programs can aid administrative functions through data tracking and data management. Use of this information will allow the administrators to make informed decisions related to the specific resources and needs of their school and/or division.

4. *Communication*. Technology can be used to communicate effectively with parents and teachers through e-mail. There is also the ability to use a school Web site as an electronic school newsletter. This can function as a school calendar containing key dates, lunch menus, homework assignments and help, class projects, teacher contact, and special events. Education of the community regarding the role of the school and the contribution to the life of the community is enhanced by online communications and e-mail.

5. *Sharing Cultural Information*. Internet technologies provide for sharing cultural information across the Internet, thus helping diverse learning and extended experiences. Contacting children in another location to share experiences adds to the awareness and understanding of different perspectives, values, and cultures.

Study Guide and Resources for Module 2

Questions to Consider:

How do I personally respond to change?
_____ Ignore it
_____ Fight it
_____ Procrastinate
_____ Research the potential outcomes
_____ Support it

Comments and questions:

What is my individual perspective on how technology should be used in schools/divisions?
_____ In the media center
_____ In the classroom
_____ For administration
_____ Budgeting
_____ Attendance
_____ Inventory

Comments and questions:

Do I need to change my perspective to accommodate others in the division?

_____ Do I need to learn more to keep up?
_____ Do others need more training?
_____ Do others need more support?
_____ Do we need to reach consensus on needs?

Comments and questions:

Do I need to modify my approach to _change_ in order to accomplish the needed integration of technology into the core curriculum?

_____ Do I need to slow down
_____ Do I need to speed up
_____ I'm fine

Comments and questions:

How do I use technology to meet my individual work needs? (What software applications do I use?)

_____ Word processing
_____ Spread sheets
_____ Data bases
_____ Internet/WWW
_____ Email
_____ Desktop publishing
_____ Graphics programs
_____ Content related software
_____ Language arts
_____ Math/science
_____ Social studies
_____Other:_____

Comments and questions:

How comfortable am I with trying new technology?

_____ Not at all
_____ Somewhat
_____ Very

What factors are involved in your comfort level with technology?

_____Knowledge of software/hardware

_____Experience with software/hardware

_____Training with software/hardware

_____Support (technical and emotional)

How have I managed other change processes in my school/divisions?

_____ With ease

_____ With great difficulty

_____ With finesse and acceptance

_____ With force and rejection

_____ Haven't managed at all

What was successful in these efforts and what could be better?

Community involvement:

Staff/Faculty involvement:

Student involvement:

How can I help to minimize barriers to successful technology integration?

_____ More involvement of others

_____ Lay down the law

_____ Eliminate barriers (people, programs, etc.)

How can I be an effective team leader for technology integration?

_____ Enthusiasm

_____ Knowledge

_____ Support

_____ Identify people to help

_____ Relegate/delegate

Resources and Supplementary Materials:

Web sites with information related to the change process and the steps needed to successfully implement a technology integration plan.

Horace Mann School Technology Integration Project
http://www.cas.american.edu/~hmann/hmtip.html

Factors Limiting Technology Integration in Education: The Leadership Gap (online paper)
http://www.coe.uh.edu/insite/elec_pub/html1995/152.htm

National Center for Technology Planning
http://www.nctp.com/

The Institute for the Transfer of Technology to Education (ITTE)
http://www.nsba.org/itte/

Using Technology to Support Education Reform
http://www.ed.gov/pubs/EdReformStudies/TechReforms/

CEO Forum on Education & Technology
http://www.ceoforum.org/home.cfm

Bellingham Public Schools Technology Plan
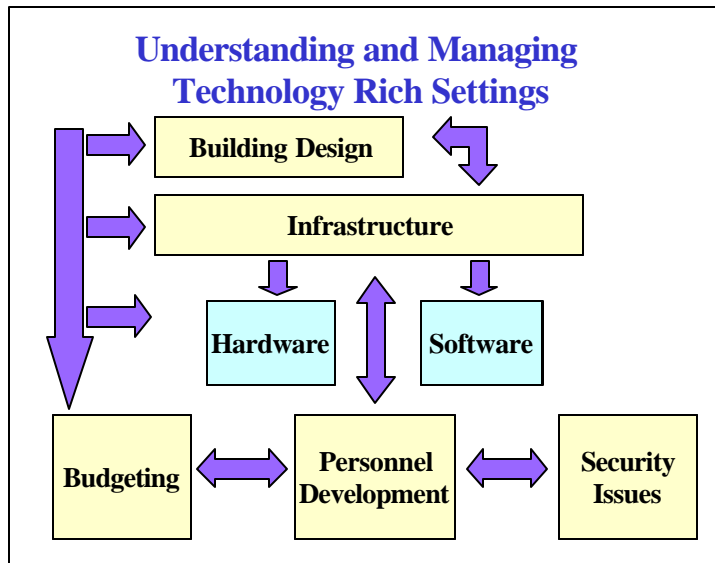http://www.bham.wednet.edu/technlgy.htm

Planet Innovation
The goal of Planet Innovation is to support the integration of meaningful technology innovations in schools. Planet Innovation provides tools that assist school administrators and teachers in successfully planning, implementing, and evaluating technology.
http://planet.scrtec.org/menu.html

Technology Planning: The Good, the Bad and the Ugly
http://agent.microsoft.com/education/instruction/articles/planTMM.asp

Module 3: Understanding and Managing Technology Rich Settings

Understanding and Managing Technology Rich Settings

Building Design

Infrastructure

Hardware

Software

Budgeting

Personnel Development

Security Issues

The purpose of this module is to provide basic information regarding aspects of the physical plant, connectivity, hardware, software, maintenance, security, support, and training. The following topics are addressed; information on building design related to learning and technology; infrastructure is addressed in relation to the needs of the division and the educational plans that have been established; hardware and software are discussed in relation to school division plans based on the administrative and academic applications identified by the school leadership; critical security issues are presented and discussed; fundamental training and support issues are included, focusing on the critical need for enlightened users and essential support personnel.

Building Design for Learning and Technology

The Thomas Jefferson Center for Educational Design urges the consideration of the following principles:

- A good learning environment is one that reflects a clear understanding of how people learn.

- A good learning environment is one that reflects the prevailing ideals and values of the community supporting it.

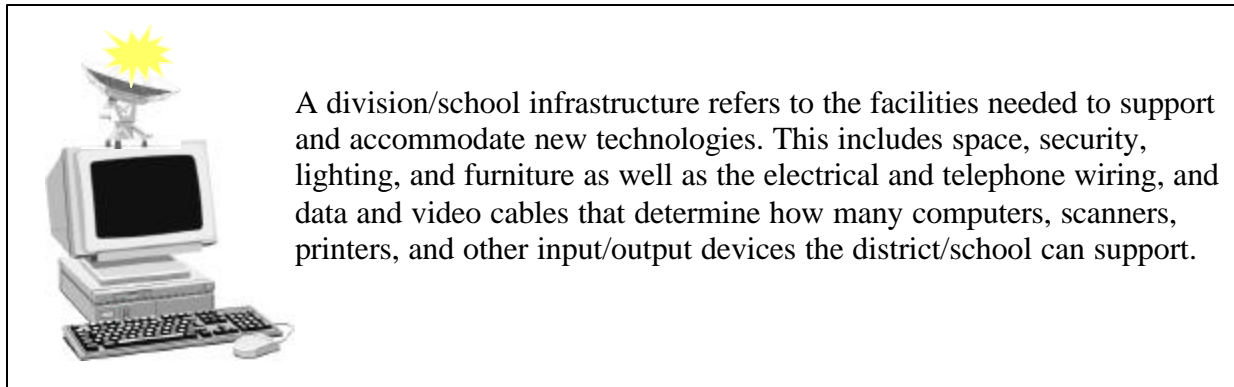- Pervasive caring and help characterize a good learning environment.

- A good learning environment is one that inspires and nurtures hope.

- A good learning environment is one in which the quality of desired learning experiences dictates the quality of the setting.

Building Specifics
The following are considerations for school buildings in relationship to technology planning:

- ✓ Electrical capacity-power sources and placement of outlets is important.
- ✓ Lighting
- ✓ Routing of network connections
- ✓ Telecommunications options
- ✓ Layout of classrooms and/or labs
- ✓ Workstation capabilities
- ✓ Mobility and comfort requirements
- ✓ Internet capabilities within the building

Infrastructure

A division/school infrastructure refers to the facilities needed to support and accommodate new technologies. This includes space, security, lighting, and furniture as well as the electrical and telephone wiring, and data and video cables that determine how many computers, scanners, printers, and other input/output devices the district/school can support.

The first step in infrastructure planning is to assess your technology needs. Questions to consider:

1. What is your vision for technology at the division/school level?

2. How do you envision technology being used for instructional purposes?

3. How do you envision technology being used for administrative purposes?

Infrastructure Details
When planning for infrastructure consider the following:

- Types of connections
- Maintenance of wiring and routers
- Support specifications

- Support requirements
- Planned upgrades
- Building security.

In addition, as you are assessing your current level of technology infrastructure consider the following questions:

Is the division connected to or have access to a Wide Area Network (WAN)?

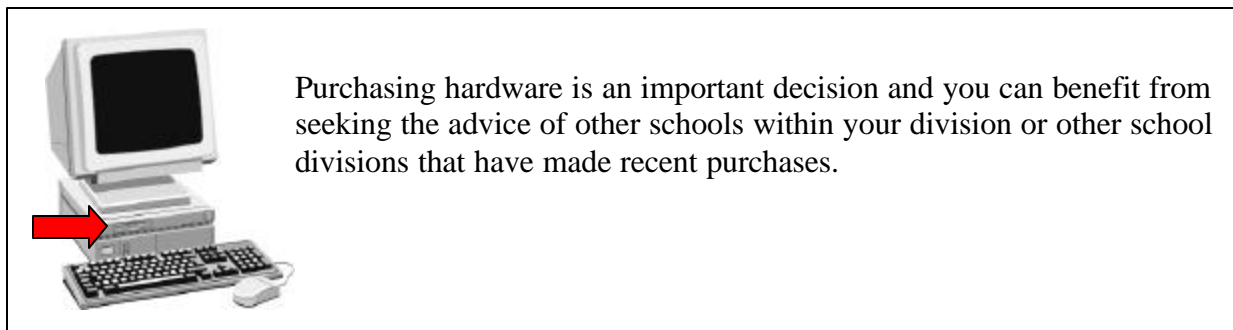Is the division office connected to the Internet?

How many schools are networked to the division office?

How many schools in the division have local area networks (LANs)?

How many school computer labs have Internet connections?

Does the division have a current technology plan?

Hardware

Purchasing hardware is an important decision and you can benefit from seeking the advice of other schools within your division or other school divisions that have made recent purchases.

Some important points to consider are:

- Flexibility—Can the machine be used for multiple purposes (instruction and multimedia authoring)?

- Ease of use

- Good and relevant documentation on the operation of the machine and peripherals

- Expandability—How reasonable is the cost to upgrade the machine?

- Manufacturer's reputation

- Dealer's reputation

- Service options

- Warranty plans

Technology is constantly changing and improving. It is likely that improvements in technology will render the hardware you buy out of date within a few months of purchase. At any given time you can expect to be either one step ahead or behind the latest technology; however, you should not let the fear of obsolescence prevent you from making hardware purchases.

Examples of Hardware:
modems
printers
central processing units (CPU)
monitors
scanners
digital cameras, and so forth

General guidelines for hardware specifications
Color monitor with 256 colors and a resolution of 640X480 pixels (at least 15-inch monitor)
Built-in hard disk
Built-in CD-ROM drive
Built-in local area network support
High speed, internal modem (*56.6 kb/sec) if Internet connections are made through regular phone lines
Internal or external storage device (Zip drive) for storage of large files associated with multimedia projects
Sound card
Video card

Maintenance Schedule
Maintenance costs should be included in the hardware budget. Consider the following questions:

Will your school/division budget support an on-site technology support person?

Does the manufacturer offer an extended warranty?

What is covered in the initial and extended warranty?

Will the manufacturer pick up and deliver the machine or will you have to incur that cost?

Hardware Purchases
Hardware purchases should be driven by the curriculum and the software that is going to be used. But first ask: What is it I want to accomplish in the classroom?

The next two most common questions are:

What kind of computers should I buy?

How many should I buy?

The school/division's vision for technology's role in education should drive this decision. When making hardware purchases you should be mindful to buy computers and peripherals that meet your school/division needs. The (how many?) question can also be answered by referring to the school/division plan. How will the machines be used, and how frequently will they be used? A good equation to use in helping determine the number of machines to purchase is that on average, one machine for 10 students calculates into about 30 minutes of computer use per student per day. This formula can be used to calculate computers based upon the student population in your school/division technology plan.

Software

It is important to make software purchases that are driven by the curriculum. What do you want students to be able to do with software?

Consider the following:

- Set instructional priorities

- Search for available software to meet those priorities

- Look for evaluations of the software you are interested in purchasing

- Conduct site-evaluations of the software

Note that there are three categories of software:

A. Applications software

B. Programming languages

C. Systems software (also called the operating system)

Software planning should also include the following:

1. Site/educational institution licensing providing adequate resources. This refers to purchasing licensing agreements that allow enough users to benefit from the software. Some manufacturers have classroom packages available.

2. Personnel

3. Upgrade schedules

4. Assessing technical support from manufacturers. This is important because if software does not adequately perform and the manufacturer does not have toll free assistance, longdistance charges can escalate rapidly.

5. Planning sufficient training time

6. Coordinate with hardware planning

Selecting Software

The following are some guidelines for selecting software that were developed by Olds (as cited in Neill, 1984)

1. Quality software should be the outgrowth of a fully conceived and carefully articulated intellectual model of the content domain (e.g., good science software should represent the best current scientific understanding).

2. Quality software should reflect an understanding of the cognitive developmental needs and capacities of the learner (e.g., younger children need more concrete representative experiences).

3. Since the computer provides an environment for interaction, its best pedagogical use should support the inherently interactive nature of knowledge construction for the learner (e.g., the computer is a poor medium for giving a lecture).

4. It should make use of the special qualities of computer technology in truly functional ways (e.g., use graphics to make abstract concepts concrete). It should not attempt to carry out instructional tasks that are better suited to other media.

Budgeting and Upgrades
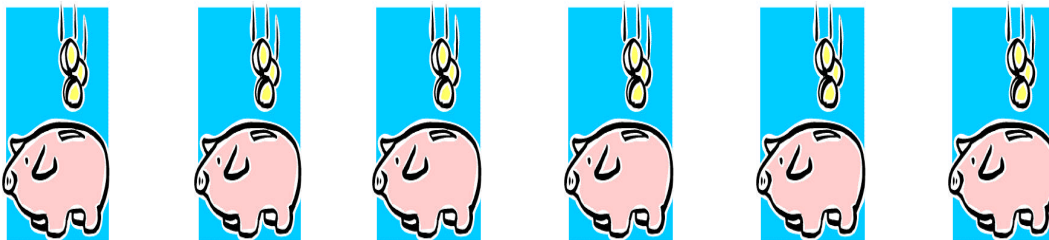
Budgeting for technology can be divided into two categories, capital expenses and recurring costs. Costs like telecommunications services, staff development and software upgrades may be incurred every year, while other costs such as hardware purchases may be incurred every five years.

Ongoing Costs for Personnel to Manage the Technology
It is important to budget for personnel to manage the technology. In fact, positions such as technology coordinators and network administrators may need to be funded. These are important support personnel to a successful technology integration program.

Personnel Training
At least 30 percent of the technology budget should be allocated for professional development. If a significant investment is not made in technology professional development, it is likely that hardware and software purchases will be for naught because teachers will not be adequately prepared to use the technology.

Upgrades for Hardware and Software
Technology is rapidly changing; however, you should expect your hardware purchases utility to last about three to five years.

Hint: Spend year-end money on software, not hardware. (Computers purchased at the end of the school year will likely be out of date by the time they arrive in fall.)

Repair and Maintenance
Repair and maintenance costs should be budgeted with your hardware costs. These should be considered recurring expenses and budgeted as an ongoing expense.

Related Costs
When developing your technology budget, remember to include costs that may not be easily associated with technology. These types of costs may include:

- A line item for consumables (paper/toner)

- A line item for furniture (computer desks, tables, carts)

- A line item for telephone lines or fiber optic connections for Internet access.

Personnel and Staff Developments

Planning for technology staff development must be thorough and include all relevant stakeholders. Teachers should be involved in the decision-making processes affecting technology staff development. Other stakeholders include those responsible for curriculum planning, budget, testing/evaluation, and the school or division technology coordinator.

Questions to consider:

What will be taught?

When?

Where?

For how long?

Also, when planning a staff development program it is important to keep in mind that the training will need to address a wide range of teachers' knowledge, skills, attitudes, and concerns. Some teachers will be apprehensive about using a computer while others will be proficient users, needing only guidance in pedagogically sound ways to integrate technology into the curriculum.

Release Time to Attend Training on New Software and Hardware
The four T's of staff development are:

Time: Time for staff development outside of the school day in two-to-three-hour after school sessions. This also includes release time for staff development and planning.

Training: If teachers see the relevance of technology to what they do in the classroom, they are more likely to incorporate it into their instructional strategies.

Technology: Match the training with the technology available in teachers' classrooms. Teachers often get frustrated when they learn how to use tools that are not available for their immediate use in the classroom.

Teacher-type tasks: Teachers should actively participate in training and be required to integrate technology into their instruction and serve as mentors for other teachers.

Release time is an important way to help establish the goals of a staff development program.

Effective Training with Follow-up with Teachers
Joyce and Showers (1988) found that staff development design makes a difference in the change process as it relates to teachers' classroom practices. They identified four incremental categories of staff development:

Presentation of Theory: The talking dog and pony show, few teachers actually change their instructional practices after this level of staff development.

Theory and Demonstration: Transfer is slightly higher if staff development includes a demonstration.

Theory, Demonstration, and Practice: Skill increases, but actual classroom practice only increases slightly.

Theory, Demonstration, Practice, and Follow-up: This level of staff development is most successful in the transfer of skills learned to actual classroom application. The staff development plan must include coaching and follow-up overtime.

Follow-up is an important aspect of successful professional development. Staff development is not over when the workshop or course ends. For an increased return on the investment made for technology staff development, significant resources need to be available for follow-up activities. These activities may include peer-coaching teams, train-the-trainer activities, and peer collaboration groups organized by grade level of department.

Important! An integral part of supporting follow-up activities is allocating adequate time for teachers to practice what they have learned.

**Ongoing Technology Support for All Personnel**
It is important to budget for ongoing expenses for technology support. The success of a technology integration program can be significantly hindered if teachers try new technology and are unsuccessful because of a lack of tech support. Technological support can help ease frustration and aid in problem-solving, thus encouraging teachers to try new technology and approaches.

Effective In-service Assumes a Continuous Learning Curve
The following are some hints for a successful technology staff development program:

❖ Establish organizational structures that provide a context of support for technology staff development, including a shared vision for technology in schools and an evolving long-range plan.

❖ Provide access to technology. Match the hardware and software used in training with the resources available to teachers in their classrooms.

❖ Provide time for practice, to work together, planning, and other activities.

❖ Design follow-up activities that include opportunities to practice new skills and receive feedback.

❖ Acknowledge and address different levels of teachers' concerns.

❖ Consider incentives that reward mastery of technology competencies.

❖ Let teachers play. Idea: Adopt a computer loan program that allows teachers to take computers home during the school year and during the summer break.

❖ Training should be hands-on with a machine for each person.

❖ Training should be ongoing.

❖ Technology integration should be the main focus of staff development rather than specific applications training.

Security Issues
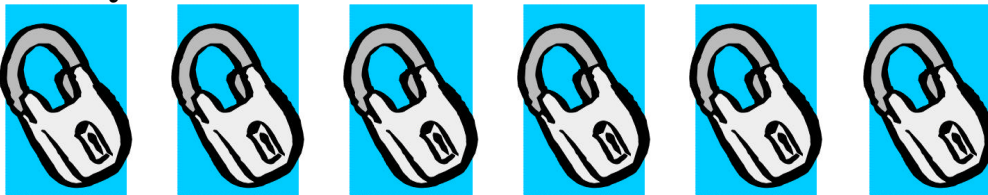
Security issues are an ongoing concern and need to be addressed with an integrated approach to problem prevention. Security issues include the following:

1. Restricting access to sensitive information

2. Building security

3. Lab security

4. Virus protection

5. The need for a realistic acceptable use policy

6. The need to involve parents in an acceptable-use policy

7. The importance of teaching and modeling responsible computing

Study Guide and Resources for Module 3
Questions to Consider:

I. Building Design:

What are the most critical design issues for your school/division?

Are you looking at remodeling older schools?

Does you design for new schools meet the requirements for full-scale networking and allow for future growth?

II. Infrastructure:

Do you have an up-to-date technology integration plan? (Is it detailed and comprehensive?)
    _____ Were students, parents, teachers, and community members included
      in the planning process?
    _____ Does this include a needs assessment?
    _____ Does this include future needs?
    _____ Are you planning new buildings?

What is your vision for technology at the school/division level?
    _____ Don't think it is important.
    _____ Haven't had the time to consider.
    _____ Working on it by myself.
    _____ Soliciting input from students, teachers, and community.
    _____ Have a vision statement.

How do you envision technology being used for instructional purposes?
_____ Students will be taught how to use computers.
_____ Students will learn technology skills.
_____ Technology will support existing instruction.
_____ Technology provides opportunities for new learning paradigms.

III. Hardware:

Whom may I contact for technology information?
_____My school/division
_____Administrators
_____Educational software vendor
_____Hardware vendors
_____Virginia Department of Education
_____College of Education faculty

Does my school/division technology plan include:
_____ A repair/maintenance schedule?
_____ Hardware upgrades?
_____ Networking of shared resources?
_____ A system for ensuring compatibility between hardware/software?

Does my school/division technology plan include:
_____ Ways to ensure teachers' input into purchase decisions
_____ Ways to ensure hardware/software support the curriculum
_____ Ways to ensure hardware runs software teachers' need/want
_____ Time for staff/teachers to learn new software

Does my school/division have someone that oversees hardware and ensures compatibility between hardware/software and curriculum needs?

IV. Software:

Is there an effort to ensure that software supports curricular goals?

Will the existing hardware run software that teachers desire in their classrooms?

Is time allocated for staff to learn new software?

Have you considered obtaining site licenses?

Have you considered phasing in new classroom based software by offering a one-year trial of the material before full purchase and routine classroom use?

What arrangements with software vendors could be considered to assure competitive pricing and regular updating?

V. (a.) General Budget Issues:

What is my school/division technology budget?

How much is soft (grant) money?

Is there a separate technology budget?

Does the budget reflect the school/division values with respect to technology?

What is included in this budget?
     _____ Hardware
     _____ Software
     _____ Upgrades
     _____ Personnel costs for technology management
     _____ Repairs/replacement
     _____ Training costs (including release time)
     _____ Consumables (ink jets, paper)

Are added personal costs covered in the budget? (This is related to the non-teaching personnel that are required in the technology rich setting.)

Additional items and comments:

V. (b.) Budget Specifics:

Does my school/division plan include ongoing budget items for personnel to manage the technology?

Does the budget include expenses for staff training?

Are online charges and service provider charges included in the budget?

How is maintenance and repair covered in the budget planning process?

VI. Personnel:

How does my school/division ensure that all personnel are technologically proficient?
_____ By providing release time for staff.
_____ By providing ongoing technical support for all staff.
_____ By following up after training to encourage transfer of skills into
      the classroom.

Is there a recognition system for teachers whom will take the extra effort required to be effective users of technology in the classroom?

VII. Security Issues:

My school/division acceptable use policy:
_____ Had parental input during development
_____ Is reviewed annually
_____ Is explained to students and teachers
_____ Is explained to parents and community members

**Do key division/school personnel know the acceptable use policy?**

How is the acceptable use policy implemented?

Resources and Supplementary Materials:
An excellent resource for comprehensive material geared to increase the user's knowledge base on educational/instructional technologies and equipment can be found at the following URL:
http://www.g3.net/institute tmls/index.html

Module 4: The Role of Technology in Education
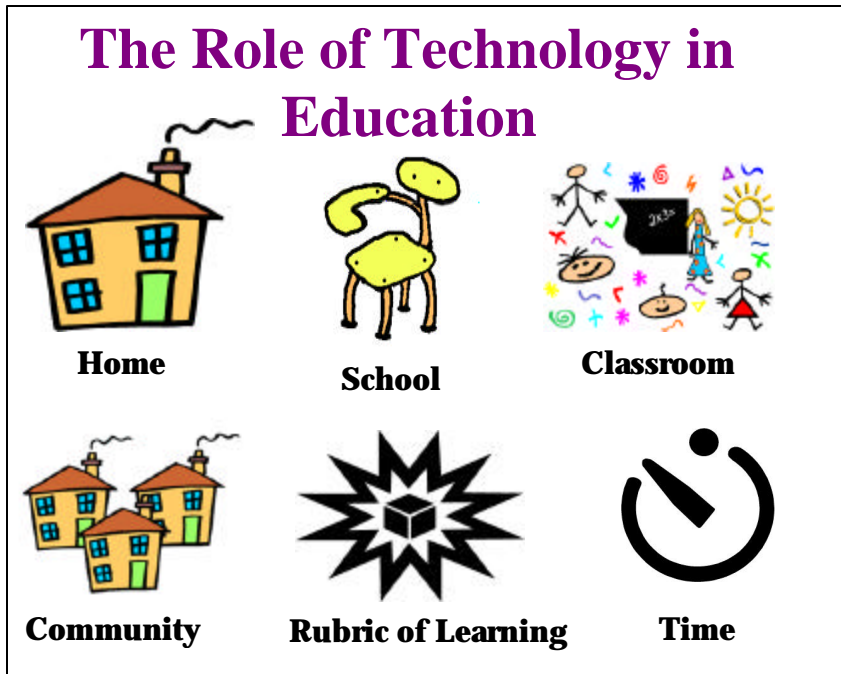
The role of technology in education is important, and understanding the change process is a key component of successfully implementing a technology program.

Change in the Home

Technology can change how learning occurs in the home. Computers in the home can encourage parents to e-mail teachers about their child's progress, help students complete homework assignments, and serve as an educational resource.

- **Facilitate Parent-Teacher Contact**

Changes in the way teachers can communicate with parents is one aspect of technology that provides both new opportunities and potential difficulties. In the past, teachers used parent-teacher conferences, telephone calls, and school newsletters to communicate with parents. In elementary school, notes pinned to the jackets of children on their way home was another method of ensuring that parents received important classroom information. E-mail and Web pages provide electronic communication directly to parents who have access to computer technology. Teachers can directly e-mail notices and schools can use Web pages as electronic newsletters. It is important to remember that all parents may not have electronic access. Until electronic access is as common as universal telephone access, administrators must maintain multiple ways to communicate with parents.

- **Help Students With Homework**

Technology provides new ways to help students complete homework assignments. Web surfing can be used to access information resources for papers. In addition, there are specific chat rooms and Web sites where teachers offer homework help. For example, the www.grammarlady.com site can help answer questions related to punctuation, grammar usage, and spelling. There are also chat rooms where teachers are available on-line to help students with math questions.

Again, equity and access are issues that administrators will need to consider. For example, some students may have access to these resources at home while other students may only have computer access at schools. Opening computer labs after school or providing a homework period during the day where students can use the technology for assignments may be solutions to these types of concerns.

- **Serve as an Educational Resource**

Technology provides an excellent resource for learning, but the need for effective problem-solving skills and information literacy is evident in selecting uses of the vast amount of resources available. It is important to help students understand what resources are most appropriate for which types of problems. It is also important to develop assessment and evaluation skills so the quality of the information obtained through the Web can be analyzed. In short, while technology provides many opportunities for expanded knowledge and resources, to effectively utilize these expanded resources students must be able thinkers and problem solvers.

Change in the School

Technology can change the school environment by networking computers and increasing educational resources.

- **Range of School Environment**

Technology can extend the range of the school environment by providing a tool that can encourage communication with parents, teachers, and students.

- **Learning Opportunities Through Networking**

By using networking capabilities, schools can offer learning opportunities that are independent of time and location. This can help provide schools with a different paradigm when thinking about accomplishing educational goals. For example, students who are being tutored at home due to illness may participate in class through networking and video links. Some schools may find it helpful to reconfigure the school day to support other activities of students and encourage off-school attendance for classes. For example, to serve homeless students it might be helpful to offer classes that could be made available through the local library so that students could attend while living in a homeless shelter. Another example, is the possibility of offering information to parents via networking that could help parents provide homework assistance to their children.

- **Increased Educational Resources**

Technology can increase local educational resources through the Internet, World Wide Web (WWW), and connections with other institutions. Many universities and museums are creating searchable Web-based archives on topics that are available to anyone. There is also the possibility of collaborating with schools and professionals at a great distance; for example, foreign language classes collaborating with classes in the country of the language. A Paris high school class could become a sister class to a local French class, thus encouraging language skills for both groups of students. In the past, NASA has created Web pages and e-mail possibilities so students may communicate with astronauts and scientists working in space and at the earth-bound space agency. Isolated rural schools with network capabilities can have the same access to these resources as large urban schools.

Change in the Classroom

Technology in the classroom can change the learning environment for teachers and students.

- **Change the Learning Environment**

Technology can change the learning environment in many ways. In a classroom where technology has been integrated into the curricula, it can be a tool for students to use while engaging in project-based learning. It can also help to foster collaborative learning in the immediate classroom and collaboration with others at a distance. The software purchased for use in a classroom must support the overall educational goals of the curriculum while enhancing the teacher's ability to explore new learning opportunities with students. Appropriate software selection to meet educational goals is a critical component of any successful technology plan. Technology is not a substitute for good curriculum planning and quality teaching, but must be used as a tool to enhance student learning.

- **Teachers as Guides and Educators**

Technology encourages teachers to move beyond a lecture-based format in their teaching to different models that actively engage learners. For example, the Geometer sketchpad provides a tool for students to explore Euclidian geometry by making shapes and noting mathematical interactions. Students can achieve a sense of mastery of causal relationships and visualize geometric truths through their active exploration of the program. In the past, teachers often had to rely upon lecture and working out proofs and theorems through formulas.

Many of today's students are very technologically proficient, while teachers are still in need of technology skills. This disparity in comfort levels with technology may cause some discomfort for teachers, but it also offers teachers the opportunity to empower their students. Students can help teachers use technology in the classroom, thus changing the model from the all-knowing imparter of knowledge to a model where the students and teachers are involved in a learning community.

- **Students as Self-Directed Learners**

Technology also encourages students to explore areas of interest in ways that were not feasible in the past. The WWW offers many opportunities for students researching areas of interest. E-mail and chat rooms offer students the ability to collaborate and communicate with people around the

world. It is important for educators to remember students need guidance and help in developing the skills necessary to be productive self-directed learners. When technology is brought into a classroom, teachers and curriculum planners need to consider incorporating skills students need to develop. Technology can encourage self-motivation in learners by offering avenues for exploring areas of interest. In addition, software that encourages students to explore concepts and ideas in non-linear ways can help students develop these skills. For example, Edmark's, series on the ocean and rain forests are software programs that empower students to explore concepts rather than recite facts.

Change in the Community

Technology can support community participation in education through expanding opportunities for community members, providing access to community resources to students, and fostering civic responsibility among students.

- **Community Life as an Educational Resource**

Technology can encourage community life to become an educational resource, thus encouraging student participation in civic life. Whether schools are located in isolated rural areas or urban settings, technology can improve communication with local political leaders and small businesses. Students can use technology to access census data and economic data for school projects. Students can also collaborate with local businesses on projects and enhance their work force training opportunities. Administrators can use technology to review vital local information and projections that may aid in school planning such as property tax information, census data, and growth forecasts. Technology can help to strengthen community bonds between the schools and the rest of the community. School Web Pages are an excellent way to provide community-wide information about your school.

- **Expand Educational Offerings**

Technology can expand access to community resources including recreational, business, and political resources. Many local communities and local chambers of commerce have developed community-specific Web pages that contain information on community issues. This resource can help the administrator keep in touch with community concerns and as a research tool for students and teachers. These Web pages often contain a community calendar that lists key events and opportunities for students, parents, teachers, and administrators. Many local public libraries provide networked searchable databases that anyone can use for research purposes.

- **Encourage Participation**

Technology can encourage participation in local, social, and governmental activities by increasing communication possibilities, providing ways to research issues, and serving as a community-wide bulletin board. Many local governmental bodies include their meeting minutes in online formats, which can be used by teachers to help students learn about local government functioning. This can also help to foster civic responsibility by communication with local officials via e-mail.

Rubric of Learning

The rubric of learning is important when planning for technology support to achieve educational goals.

- **Teacher Centered—Student Centered**

Technology encourages a movement away from teacher-centered learning to student-centered classrooms by encouraging students to become active participants in the learning process. For this movement to be successful, teacher training and appropriate software selection are critical factors. Teachers may need help in integrating computer technology into their classroom curriculum and should be encouraged to think about how technology can support the educational goals of their students.

- **Inquiry and Project—Based Activities**

Technology is a tool that encourages inquiry and project-based activities to increase the level of student involvement in the learning process. To foster active participation by students, teachers will need to support and create opportunities for them to learn new thinking skills.

- **Offerings Independent of Time and Place**

Technology provides educational offerings that are not dependent on time or place. Students with access to the WWW no longer have to quit their research when the library closes. Collaboration over long distances is possible through networking so that students could have a project with a class from another district. Rural students can have the opportunity to visit a museum online that would be too far to travel on a field trip.

Time

An important axiom to remember is that when implementing any technology there is a learning curve for the user. While in the long term technology can make users more productive and efficient with their time, in the short term technology may increase the time to complete some tasks. Remember, it always takes longer than you think when acquiring skills with new technology. Keep this in mind and budget extra time into task completion.

- **More Time Needed for Teacher Learning**

To successfully implement technology in the classroom, teachers must be given more time for learning how to integrate technology in their instructional programs. Support for in-service and planning time is critical to the success of learning how to use the technology and how to use the technology to teach content.

- **Process of Integrating Technology**

The process of integrating technology takes a minimum of one to three years. A critical factor in successful technology implementation is administrative support for training costs and support for the length of time needed to make changes. Encountering barriers to technology may slow progress, but barriers should be identified early in the process if possible. The implementation timeline should include a cushion of extra time so that problems can be addressed as they arise.

- **Learning Time and Concept Development**

Learning time and concept development are not dependent on seat time of the student. Technology can help learners by providing several different ways that a single concept can be learned, thus addressing individual learner differences.

Study Guide and Resources for Module 4
Questions to Consider:

What kinds of changes can technology foster in the home environment that might affect student performance in school?

Positive
E-mail—parent to teacher and vice versa
Web search capabilities
Educational software used at home
Improved parent/child interaction using educational games

Negative
Student stays up too late using computer, tired in school
Student becomes addicted to Internet
Student accesses inappropriate Web sites

What are some of the changes that impact learning in the classroom that can be affected through technology integration in classrooms?
Increased research capabilities
Opportunity to access "experts," "pen pals," and so forth
Software that can reinforce learning, drill, and practice
Software that can assist in individualized instruction

What are some of the advantages/disadvantages of the student-centered classroom?
Self-paced learning
Individual needs addressed
Peer influence
Potential loss of control
Discipline problems
Teacher threatened

What are some advantages/disadvantages of the teacher-centered classroom?
More control of learning environment

Less preparation time
Group discipline
Individualized instruction sometimes lost
Brighter students turned off
Teaching centered on mediocrity

What is your role in helping to create the classroom environment?
     _____ Instructional leader
     _____ Facilitator
     _____ Encouragement
     _____ Resource allocator
     _____ Trainer/teacher
     _____ Director/mandator

What classroom activities are most appropriate for teacher-directed learning?
     _____ Worksheets (group)
     _____ Textbooks
     _____ Rote learning
     _____ Group teaching
     _____ Media presentations (videos, overheads, etc.)

What classroom activities are most appropriate for student-centered learning?
     _____ Small group and individual projects
     _____ Computer programs
     _____ Individualized self-paced learning activities

How can you set up a means of sharing quality-learning experiences that have been supported with technology across the division? (good lesson plans, curriculum, learning experiences supported by technology)
     _____In-service training
     _____E-mail
     _____Chat rooms
     _____Web searches

What are the qualities of a master teacher who is successful in integrating technology in the classroom?
     _____ Control/discipline
     _____ Interest and excitement in teaching and subject areas
     _____ Interest and excitement for technology and its potential for teaching
      and learning
     _____ Comfort in using technology
     _____ Adequate training and preparation

How do we enable teachers to make changes needed for using technology successfully? Support by:
- ✓ Training
- ✓ Adequate budget
- ✓ Release time
- ✓ Technical assistance

What changes do we need for students to enable them to become effective technology users in the classroom?
- ✓ Instruction in use
- ✓ Age and ability appropriate software made available
- ✓ Adequate computer time scheduled

How can changing roles in the communities be used as an advantage in the educational process?
- ✓ Businesses can be tapped as classroom resources for personnel and materials
- ✓ Political structures can be lobbied to support education and technology
- ✓ Donations can be solicited for hardware and software

What community resources can have an impact on the use of educational technology?

Computer stores, companies. How?

Public libraries. How?

Business and industry. How?

Book stores, etc. How?

Resources and Supplementary Materials:

Web sites with information about how technology changes the educational process

Report to the President on the Use of Technology to Strengthen K-12 Education in the United States
http://www.whitehouse.gov/WH/EOP/OSTP/NSTC/PCAST/k-12ed.html

School Reform: What Role Can Technology Play in a Constructivist Setting? (online paper)
http://pixel.cs.vt.edu/edu/fis/techcons.html

Benefits of Advanced Telecommunications in the Classroom
http://www.princeton.edu/~edutech/benefits/ben_level_1.html

Partnering with Technology (online article)
Chris Dede talks about the potentials that can be reached through the proper use of technology.
http://www.4teachers.org/keynotes/dede/

The Emerging Contribution of Online Resources and Tools to Classroom Learning and Teaching
This review identifies models of use, trends, and research gaps on the contribution of effective uses of online resources and tools in the classroom of the elementary and secondary schools and post secondary institutions.
http://www.tact.fse.ulaval.ca/ang/html/review98.html

Leadership and the New Technologies
This web site supports school district leaders using technology to improve teaching and learning.
http://www.edc.org/LNT/

Improving Student Learning Through Learning Technologies: A Policy Statement by the Council of Chief State School Officers (1991)
http://www.ccsso.org/techpol.html

Technology's Impact (online article)
http://www.electronic-school.com/0997f3.html

Journeys Beyond the School Walls (online article)
http://msnbc.msn.com/news/185000.asp?cp1=1#BODY

Kathleen Fulton's Testimony Before the U.S. House of Representatives Committee on Science, Subcommittee on Technology. May 6, 1997
Kathleen Fulton is from the Center for Learning and Educational Technology at University of Maryland, College Park.
http://www.house.gov/science/fulton_5-6.html

Module 5: The Role of Technology in Administration

Technology can accomplish the mechanics of data analysis; however, it is critical to note that decision making and uses of the data analysis are still human functions that rely upon insight and experience. Quality data analysis is dependent upon what questions are being asked, how the data is being analyzed, and what comparisons are being made. Again, it is important to know what to ask before the data analysis is begun. Software applications can only provide numbers and statistics, it is helpful to know what numbers or statistics will answer the questions you need analyzed.

Collecting, Organizing, and Analyzing Data

Technology can improve data collection for schools and divisions by helping to manage information. For example, statistics on each individual student can be easily compiled into a database or spreadsheet application. Class enrollments can be tabulated through using one of these software programs. Budget information can be compiled by using accounting software programs and graphically displayed through spreadsheet programs. To effectively use technology for data collection, preplanning to identify possible uses of the data is important so that the needed information can be collected. Data can be structured to meet any reporting format required by any number of agencies.

Technology can enhance data organization through software applications; however it is important to identify possible uses of the data before designing how it is organized. It is helpful to ask what do you want to accomplish with the data before deciding upon specific software applications. Many programs are designed to meet specific school needs and are sold as self-contained packages. Others may be customized to meet different needs as determined by the user.

Data Collection

- **Student Statistics**. There are several software application packages that districts can use to gather student information. In general, these packages contain a searchable database function so that individual student records can be located and some functions that allow aggregate totals for specific categories to be obtained. For example, how many student athletes have fourth-period gym.

- **Class Enrollment**. Some of the software packages that manage student records also have a separate application for managing course enrollment that may include registration, attendance, and class grades. For many divisions integrated software packages for both student statistics and course enrollment may be a good use of fiscal resources. Some divisions may find that the packages are too expensive and do not provide the needed functions.

- **Budget Information**. There are several software applications that can assist the school's budgeting process. For example, there are accounting packages that provide processing of accounts payable/receivable, check writing, and balancing of accounts. There are also spreadsheet programs that can be customized for budget forecasting and tracking of specific program budgets. Some spreadsheet programs such as Microsoft Excel also include a graphing function that enables data to be visually displayed for better communication and presentation of the information collected.

Data Organization

When purchasing or upgrading data collection software applications, it is important to plan for how the data collected will be used. It is easier and more cost effective to decide up front what types of data will be needed for decision making rather than trying to change the set-up in response to specific questions. (It can be done but it will take staff time to reset data fields and re- enter some data. Or, it might substantially increase programmer costs to modify the database.) It may be helpful to think about how important it is to set up your personal filing cabinet in a system that is easy for you to use but also easy for others to use when you are not available. Data organization could be thought of as digital filing, and just as in filing it is important to know how the information is stored. How the information is stored is often dependent upon how the information will be used.

Quality Data Analysis

The analysis of the data may be assisted through technology, but the ultimate analyzer of the data is the human making the decisions. Again, certain software applications may help by graphing data or presenting data in visual ways. It is important to remember that how the data is displayed is dependent upon the decision-maker deciding how and what data should be conveyed. In some cases, it might be helpful to develop a series of specific questions that you would like the data to help answer before beginning any data collection or analysis. Again, technology can support data analysis but effective decision-making relies upon the problem-solving ability of the decision-makers.

Using Data to Make Informed Decisions
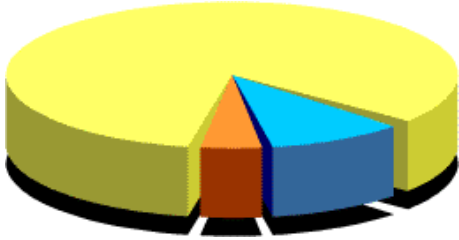
Technology can support but shall not drive the administrative decision-making process. The qualities of effective decision-making for administrators are still important and technology can be used to illustrate key points. For example, using a spreadsheet program to illustrate budget information or using a database program to identify concentrations of Title 1 eligible families. The software programs can organize the data in a manner that will *clarify* the decision-making process, but the correct data has to be obtained that allows for an *informed* decision-making process.

Administrative Decision Making

Technology can support but shall not drive the administrative decision-making process. For example, the fundamental goals of the curriculum should be supported by technology not supplanted by it. Remember that technology is constantly changing so no curriculum should be developed with a specific technology or software application at the core. The educational goals should be supported through technology. Administrative processes should be facilitated by the effective use of technology and if a process is being hampered or slowed because of technological change, thought should be given to what the goal of the process should be.

Effectively Presenting Key Concepts

Remember the process of decision making can be supported through technology, but should not drive the decision-making process.

Using Programs for Efficient Data Collection and Communication

- **Identify and Follow State Guidelines**

It is important to use technology to support data collection that is within state guidelines. For example, student record management programs can provide school enrollment figures and related data required by the state.

- **Identify Data Collection and Storage Needs**

Systematic thought should be given to how efficient data collection will occur. (Also who has primary responsibility for data entry and how will this occur at different stages of the data collection process?) In addition, planning and implementing a plan for data storage is essential. Just as paper records, digital records need to be kept for long periods of time and they should be accessible. Something to consider when upgrading hardware and software applications, is how will data on previous systems be accessed with the new software or hardware.

- **Formats for Data Output**

It is important to ensure that selected data collection and management programs can produce data in several formats and in several ways. For example, it might be helpful to have a text-based format that is also capable of output in a word processing format. Also, it is important to be able to output the data in a number of different electronic formats for transmission over the Internet.

Technology to Enhance Communication With Students, Teachers, Parents, Community Members, and Officials

Technology can be used to increase avenues of communication throughout a school division. E-mail can be used to communicate both within and without a school division. Divisions may be networked so each classroom and office can receive information from a central source. In many areas, parents are communicating with teachers via e-mail. There are also after-school chat rooms that have been set up to help students with their homework. Presentation software can be used to help communicate in meetings using structured presentations and multimedia displays.

E-mail
E-mail is just one way to communicate with all interested parties involved in public education. Many parents appreciate weekly e-mails from their child's teacher. It is also a convenient way to communicate key policy matters to school personnel. A word of caution, e-mail can easily become too much, too often and overwhelm people. It may be helpful to view e-mail as a helpful tool that can become too much of a good thing. Reading e-mail on a daily basis may become a time management issue for the busy administrator. Some e-mail systems have advanced features that allow you to send an automatic reply or notify senders when you are on vacation. It may be helpful to explore these features and options.

Networks
Networks are a good method for effective communication. For example, a local area network (LAN) can enable several computer desktop users to use a single printer. It can also be used to set up an in-house e-mail system so users can communicate with each other.

Chat Rooms
Chat rooms can be helpful ways to communicate in real time. Teachers can use it to communicate with other teachers. Social support and ideas can be exchanged in an informal way. While chat rooms have many positive uses, it is important to remember that in the vastness of the Internet, not all chat rooms are places children should be visiting. Commonsense precautions should be employed when allowing children to use this type of electronic communication.

Presentation Software
There are several software applications that can be used to aid in presentations to parent-teacher groups, school boards, and community groups. An example of this type of software application is Microsoft PowerPoint. A few helpful hints for the PowerPoint user:

1. Always make overheads when traveling or using equipment that is not your own. Sometimes quirky things happen and your presentation won't run on the system available.

2. Dim the lights, but don't turn all lights off. Leaving your audience in the dark encourages sleeping and inattentiveness.

3. Use high contrast colors for text and background. For example, yellow text on a blue background.

4. Limit the gee whiz transitions and special effects. Used sparingly they can help make your point. Overuse bores your audience with cute antics.

5. PowerPoint should be used to support your content, not overwhelm you or the importance of what you are communicating.

Programs to Facilitate Scheduling
There are specific software applications that can enhance scheduling. These programs function like an electronic calendar. They can be used individually or networked so that all key activities in a class, school, or division can be noted. There are also programs that allow individual children to be tracked so that the location of specific children can be noted. For example, in a large high school where class periods change every hour it could be noted that the members of the baseball team are in gym during 5th period.

Individual Electronic Calendars
There are software applications that function as individual calendars. These applications can be useful in time management for individuals and in some cases interface with other devices such as a Palm Pilot (a small hand held device that has the capability to schedule important dates, keep names, addresses, phone numbers, and the details in Address Book, maintain a To Do list, write memos, and track expenses.)

Network Electronic Calendars
Networked calendars have the advantage of letting all users on the network communicate about their schedules making meetings easier to set up.

Class Schedules
Some software applications allow parents, principals, teachers, and other school staff to locate where specific children are in the building at any given time. This can be helpful when attempting to locate children who have a home emergency.

Understanding the State Department of Education's Role

Understanding the state Department of Education's role in promoting technology is important. The state maintains a Web page that contains important information on process and implementation. The state Web site includes helpful information. It is important to follow what the state Department of Education has identified as the role of technology integration. Superintendent's memos on this site provide up-to-date communications for local school divisions

"Ultimately, teachers are responsible for the use of technology in the classroom. The successful integration of technology depends largely upon the existence of a well-developed teacher training and technical assistance program."

-Six Year Educational Technology Plan for Virginia VDOE

Study Guide and Resources for Module 5
✎ Questions to Consider

Are your data collection processes properly reflecting expected changes related to the learning process? (A lot of data collection is not measuring what you expect to change.)

What information is most useful for planning projected school budgets?

Are you using the data for adjusting implementation of the existing plans?

Can you tell from the data what is changing (if anything) and is it a desirable change?

Will any changes require more/less funding?

Do you use e-mail?
     _____ Personal
     _____ Professional
     _____ Listservs
     _____ Chat rooms

If so, are you familiar with the advanced features of your e-mail system? (Can you open/send attachments? Send automated messages?)
     _____ Forward
     _____ Group lists
     _____ Nicknames
     _____ Address book
     _____ Copy to

Do you use e-mail to communicate important information throughout your school/division?

Selected lists?

Use e-mail regularly?
     _____ daily
     _____ weekly
     _____ monthly

Have you used PowerPoint for a presentation? (Any other presentation software is OK! Please indicate if you use another package. _____)

　　　　　_____ Locally
　　　　　_____ Statewide
　　　　　_____ Nationally

How did you learn to use it?

Did you need extra help?

Did you get it (extra help)?

Who provided the help?

If you used PowerPoint (or a similar software package), what were some of the advantages/disadvantages of this software application in communicating with your audience?

What scheduling software have you used recently?

How did you select it?

Was it recommended by someone or given to you by the administration? Did you have any choice?

Were you satisfied with it?

Was it an improvement over previous methods used for scheduling?

What were some of the benefits of this software application?
    _____ Less time required to accomplish the task?
    _____ More flexibility in accommodating changes?

Have you visited the Virginia Department of Education Web site?

If so, was it helpful?

What suggestions for improvement do you have?

Can you locate information on the SOL, organizational structure, and the state role in technology integration on the Web site?

If not, do you know what the problem is?

Have you called the state Department of Education for assistance?

Resources and Supplementary Materials:

http://www.pen.k12.va.us

Module 6: Staying Ahead of the Game: Setting Your Own Course

Staying Ahead of the Game: Setting Your Own Course

- Understanding the Use of Current and Emerging Technologies

- Knowing When Technology is Appropriate and When it is Not

- Finding a Way to Allow Traditional Education Values and New Values and Ideals to Complement Each Other

- Using Technology to Enhance Communication at All Levels

- Involving Industry in the Educational Process

To stay ahead of the game, it is important to know what technology can do, when it is ready for use in schools, and the cost of purchasing and maintaining new technologies.

Understanding the Use of Current and Emerging Technologies

Technological innovation is an ongoing and emerging process. It is vital to be aware of and up to date on technological innovation while understanding what are the overall educational goals. Some emerging technologies may benefit the identified goals while others may not meet the needs. It is also important to budget for purchasing emerging technologies. When reviewing emerging technologies, it may also be helpful to consider how the technologies can help foster new thinking. For example, a new technology may provide a mechanism for re-thinking how a process is completed.

Knowing When Technology is Appropriate and When it is Not

 A key element of a successful technology plan is to understand appropriate uses of current technology. Technology should be utilized as a tool to achieve educational goals. That may mean identifying educational needs and goals prior to the purchasing technology or implementing a technology plan. Due to the rapid pace of change in technological innovation, the state of current technology will always be in flux. What is current today may be outdated in less than six months. A technology plan should be built upon the foundation of what it is that you want to accomplish; not with technology based on what is fashionable at the moment. Inappropriate technology does not support educational goals and is not user friendly. Technology that users can't or won't use is expensive and inappropriate.

Finding the Way to Values

It is important to find ways to allow traditional educational values and new values (ideals) to complement each other. The recent goals of education have not changed dramatically, but there is a new emphasis on technology as a tool to achieve the goals.

Using Technology to Enhance Communication at All Levels

Technologies can support and facilitate communication throughout school divisions. This can help improve communication concerning key events and policy changes and promote better cooperation among different units.

Involving Industry in the Educational Process

Promoting better relations between schools and industry will greatly enhance technology integration in the schools. Industry can provide two valuable resources to schools as a catalyst for integrating technology. The first resource is the expertise of individuals in industry, either in issues involving technology or the application of content knowledge relative to curricular items (for example, manufacturing processes, scientific information, and communication opportunities.) As the second resource, industry can become a partner in public education by providing assistance in obtaining equipment either through gifts, grants, or sharing used equipment. Providing financial assistance for the schools gives industry a tax deduction and promotes friendly public relations within the community. Tapping industry resources as a partnership will lead to strategic alliances that allow for community development and improved school-industry relations.

Study Guide and Resources for Module 6
Questions to Consider:

When is technology appropriate in your school/division?
_____ Whenever it is used
_____ Administrative use
_____ Classroom applications
_____ We're not ready yet

Comments and Questions:

What is the educational purpose of using multimedia computers and CD-ROM materials in classrooms?

_____ Greater visualization of material
_____ More interesting for the students
_____ Increases learning options for the students
_____ Greatly expands the type of experiences available to the students

Comments and Questions:

What benefits are there to using Web-Based instruction in your school/division?

_____ Wider research base
_____ Increase contacts with "experts"
_____ Increase options for individually directed learning
_____ Increasing amounts of interactive learning projects

Comments and Questions:

What values are exemplified in your school/division technology planning process?

Do these values reflect your school/division educational values?

Does your school/division have an educational mission statement?

Is this statement endorsed by:

     _____ Teachers
     _____ Administration
     _____ Staff
     _____ Students
     _____ Parents
     _____ Teacher associations
     _____ Community members

If so, does this mission statement include technology integration in classrooms?

How can you help ensure that the educational values of your school/division are included in your technology plan?

     _____ Clearly identify what you think the values should be
     _____ Attend as many meetings related to technology that you can
     _____ Articulate your views to all involved
     _____ Invite input from all key players in the school/division

Can you list several industry people in your community who can serve as a resource?

Do you attend local chamber of commerce meetings, Kiwanis, Rotary, or other places where you can network with business people in your community?

Have you included local industry people in your school/division planning efforts?

Have you had conversations or contact with industry people regarding workforce literacy (technological training, work habits) and incorporated their concerns into your school's/district's educational goals?

Resources and Supplementary Materials:

Web sites that discuss current and emerging technologies. Emphasis on guidelines for knowing when technology is important and strategies that can be used to choose an appropriate course for technology implementation.

Independent Research Results Support Educator and Parent Enthusiasm for Student Use of Laptop Computers to Learn Anytime, Anywhere
http://agent.microsoft.com/presspass/features/1998/11-10laptop.htm

ATM Network Enables Innovative Learning
http://www.networking.ibm.com/case/atm-school.html

Emerging Technologies for Active Learning
http://www.edc.org/LNT/news/Issue10/feature3.htm

Module 7: Technology for Special Needs

Technology for Special Needs

Uses for Learners with Disabilities

Uses to Accelerate Learning for Gifted Students

Uses for Learning Materials That Would Not be Available Without the Existence of Technology

This module provides information on technology for use with learners with disabilities, to accelerate learning for gifted students, and learning materials that would not be available without technology.

Uses for Learners with Disabilities

Assistive technology is technology that aids the user in performing functions of everyday life. The definition is not limited to computer technology, but anything that can help a user achieve a higher quality of life. Some examples are a hearing aid for the hearing impaired, a largescreen monitor for the visually impaired, and a laser pointer for use with a monitor.

❖ **Increases Student Access to the Educational Process**
Increased access to technology can help to minimize the effect of a disability.

❖ **Technologies can Accommodate Students with Special Needs**
Using technology, the stimulus may be presented either visually or auditorially, in a number of different modes. The presentations may be unimodal or multimodal depending upon the individual learner's optimal learning strategies. To facilitate learning by students who are unable to attend class, telecommunication can give them individualized access to education. Material can be stored on the computer to allow students extended and repeated access time and to the material to ensure the learning opportunity matches their individual learning needs.

❖ **Technology Encourages Control of Educational Process**
Appropriate uses of technology can encourage student empowerment in the learning process. For example, student independence can be fostered with voice recognition software for visually impaired students. Other forms of technology can also encourage students to become responsible for their individual learning environment, learning strategies, and for meeting their educational goals.

Technology Use for Learners with Special Needs

Learners with special needs can include learners enrolled in special education programs, students who are in inclusive classrooms, and learners who may have a need for special assistance. Technology can help each learner achieve his or her potential by minimizing physical difficulties that may inhibit classroom participation or learning.

❖ **Technology for the Visually Impaired**

Some specific technological applications for use with visually impaired students include large screen monitors and keyboards, voice recognition software, text typing software, and Braille keyboards.

❖ **Technology for the Hearing Impaired**

Technology for the hearing impaired may include but is not limited to the following: hearing aids, infrared listening devices, closed captioning on television and video, flashing lights on alarm systems (fire alarms, etc.) and telecommunication devices (TDD) for use with the telephone. Computer technology that facilitates communication such as e-mail, chat rooms, and newsgroups can be helpful to hearing impaired persons. When purchasing software, it is also important to consider software that is closed-captioned. Educational software that uses auditory cues or sound should be usable by hearing impaired students. Some software adapts by using closed captioning so that all students can benefit.

❖ **Technology for the Physically Impaired**

Technology that can assist physically challenged people can include but is not limited to the following: alternative keyboard input devices, touch screens, laser pointers, voice-activated software, text typing software, speech synthesizers, and any other technology that assists the user in performing tasks or communicating. It is helpful to consider permanent and temporary conditions that may inhibit a student's ability to function physically. For example, a student with a broken arm may also benefit from using text-typing software that is also used by a classmate with lack of fine motor control. Technology can help all learners achieve their potential.

❖ **Individual Learner Differences**

Individual learner differences can be accommodated through technology and classroom assignments using technology. For example, Howard Gardner's Theory of Multiple Intelligences proposes seven intelligences that can be fostered through the use of different software programs or technology applications. Gardner talks about musical intelligence that could be fostered by encouraging students to use software programs that enable them to compose their own music. Technology can also assist students by providing a communication medium for collaborative projects.

Uses to Accelerate Learning for Gifted Students

Technology can assist gifted students by encouraging self-paced learning that is accelerated and by fostering creative endeavors. For example, the World Wide Web is a vast information resource that students can use when developing class projects. E-mail provides the opportunity for students to communicate with scientists and others. Technology also provides the opportunity for students to collaborate with others over vast distances that can help motivate them to learn.

❖ **Access to High Level Resources**
Technology such as the World Wide Web provides gifted and talented students the opportunity to communicate with others and to obtain research/information that might not be available in a school library. Many university and college library resources are available through the World Wide Web, and students can locate and use these resources.

❖ **Modeling and Simulations**
Technology can provide models and simulations that students can use to learn abstract concepts in an accelerated manner. Self-paced learning can also enhance gifted students educational experiences by encouraging them to explore concepts ahead of their classmates. Educational CDs in game formats challenge gifted students by allowing them to proceed to higher levels of difficulty at their own pace (complete with themselves and/or the computer).

❖ **Breadth of Resources**
The World Wide Web and Internet resources provide a broad range of information on numerous topics. This can be helpful in providing access to information on specialized topics.

Learning Materials and Experiences Not Available Without Technology

Using learning materials and a variety of activities can be fostered through technology. For example, teachers have developed curriculum for specific content areas that are available on the World Wide Web. In social studies, there are student activities entitled Web Quests that use the Internet to foster skill building in the social sciences.

❖ **Contact with Individuals from Various Backgrounds**
Internet communication can encourage communication with individuals from different backgrounds. This can help to expand students' knowledge and the ability to appreciate differences between people. This awareness can be developed into an ability to work with diverse people. This is a skill that employers say is desirable in the workforce.

❖ **Can See Processes Not Normally Available for Viewing**
Technology can provide viewing of processes not normally available for viewing.

❖ **Log Networked Information**
Technology provides the opportunity to log networked information that can be used for the ongoing analysis of the educational experience. For example, a student's progress in learning material in a self-paced tutorial setting can be evaluated by mapping his or her software navigation patterns.

Technology and Furniture

❖ **Ergonomics**

Maintaining good posture while computing is an employee health concern that can be addressed through the use of special types of furniture. In addition, computer wrist rests are an inexpensive way to aid all computer users in maintaining good keyboard posture. In many ways, the principle of universal design can be of assistance to the entire school population and should not be limited to special needs populations.

❖ **Accommodations**

To successfully implement technology with special needs populations it may be important to consider how this source can help facilitate active classroom participation. There are computer tables that can be lowered or raised by cranking a lever that are not more expensive than regular classroom furniture. Examples of specific accommodations may include:

1. Tables that are at a height that a wheelchair can roll under them.

2. Closed captioning on videos and software programs that use speech.

3. Alternative input keyboards or touch screens for students who may not be able to physically use a keyboard.

4. Braille keyboards

Study Guide and Resources for Module 7
Questions to Consider:

In my school/division special education technology is:

_____ Not included in the technology integration plan
_____ A separate special education budget line item
_____ Included with the entire technology plan
_____ Included with the entire technology budget

In my school/division technology is being used:

_____ To support the curricular goals of special needs learners.
_____ To include learners with disabilities into regular classrooms.
_____ To accelerate learning for gifted students.

When making purchasing decision about software/hardware:

_____ The ADA (Americans with Disabilities Act) coordinator is
involved.

_____ Special education teachers are involved to ensure curricular goals
are addressed.

_____ Parents of special needs learners are given the opportunity for
input.

When reviewing software, special adaptations are considered:

_____ Closed captioning for the hearing impaired.

_____ Talking books or speech aids for the visually impaired.

_____ Ease of use of the software with alternative keyboard devices.

_____ Ability of all learners to use software in regular classrooms.

When purchasing classroom equipment/furniture the following are considered:

_____ Largescreen monitors

_____ Computer tables that wheelchairs can easily roll under

_____ Computer tables that can be easily adjusted up or down

_____ Special features that keep electrical cords out of the way

Is there an effort to ensure that universal design principles are used throughout the school/division to help all employees benefit from technology

✓ How are employee differences managed in an effort to minimize employee hardship and school division expense?

✓ Is the planning done up-front or after the fact?

✓ What steps have you taken or could you take to minimize barriers in the workplace?

Is there an effort to educate all school/division personnel about the need for good posture while using computers to ensure employee health and reduce injuries related to computer use?

Are you aware of the existence of repetitive motion disorders and technology available to assist in learning?

Are you aware of what can be done to prevent such disorders?

Are you aware of the procedures for involving Workman's Compensation?

Resources and Supplementary Materials:

Web sites that provide information on technology applications that may benefit learners with special needs. Also information on how learners can benefit from the special applications of technology.

Sally, a Special Needs Student Succeeds with the Web (on-line article)
Hypermedia tools and instructional programs that incorporate a range of media to address the needs of students with various learning styles.
http://www.4teachers.org/testimony/kenagy/

More associations, etc.

Module 8: Observation and Integration: What Technology Leaders Need to Know

Technology is changing more rapidly than ever before, causing more and more confusion related to the best way to use it in schools… It would be great if it would work like magic, but it seems more like hocus-pocus or maybe mumbo-jumbo.

Observation and Integration (where is info on this?)
The Essential Top 10 Concepts for Technology Integration in the 21st Century
Levels of Technology Implementation
Indicators of Technology Integration
Guidelines for the Integration of Technology into Content Areas
Seven Dimensions for Gauging Progress of Technology in the Schools
Resources for Technology Integration in the Content Areas

Technology Implementation and Integration for Administrators
Recognition
Evaluation
Implementation

What Technology Leaders Need to Know (where?)
The Essential Top 10 Concepts for Technology Integration in the 21st Century

Change
All areas of change; personal, organizational, and cultural must be considered
Leaders must accept conflict as part of change
Change is mandatory, growth is optional
The rate of change is accelerating
It takes time for change to occur
Technology is a moving target

Technology Planning
Consider all aspects; structural, hardware, software, personnel, and support
Plan to systematically reevaluate the plan
Consider entire school/division mission
Include the least amongst the greatest
Pedagogy should drive the change
Involve community and business
Consider potential obstacles
Must have clarity of vision
Use outside consultants

Ethics
Ethics should be included in all aspects of education, not only those related to computer usage.
Leadership has the responsibility for staff development in the area of ethics and proper use of technology?
Options given by technology bring increased demand and need for ethics
Access and substance of information are critical issues
Who should be the point people dealing with ethics?
Provide appropriate consequences for misuse
Better to deal with ethics not policing
Fair use policies

Teaching and Learning
Technology provides synchronous and asynchronous tools for effective learning
Allows true individualized instruction and development
Change from sage on the stage to guide on the side
Technology as a mode of understanding
Technology as an empowerment tool
Technology as a subject
Technology as an aide

Safety and Security
Use appropriate filters to give access only to quality educational material
Develop clear policies on file access and software usage
Secure hardware or provide proper checkout procedures
Encourage safe computing practices

Curriculum
Develop a process for integrating technology into basic learning; technology is the means not the end.
Meaningful use of both students and teachers at the current operational level of the school/division.
Develop a vision of how technology should be used in all aspects of teaching and learning.
Apply technology to teaching when appropriate, especially when dealing with the SOL.
Technology must complement content.

Staff Development
Staff development must be designed to make people comfortable with the equipment in the building.
Involve staff in the planning and creation of the staff development programs.
Through staff development, educators must prepare for change.
Accessible support is important.

Infrastructure
Must plan for technology when renovating or constructing a new building or developing a special project
Must plan for movement from individual machines to networking
Seek help and professional guidance
Qualify professional helpers

Technical Support
The school division must make a commitment for technical support that matches the division's technical vision.
Must be willing to compensate technology personnel in order to hire them and keep them
Must make a long-term commitment and investment in order to build a quality technology program
Increased technology use increases the need for technical support
Good staff training reduces the need for technical support

Technology Leadership
Leaders must know where to find information and/or how to get help for their staff.
Leaders must demonstrate their willingness to learn the technology expected of the staff.
Need to realize it is a shared journey; you don't have to know it all right now.
Communication and respect are critical

Stages of Technology Competence
Where are you? Where are your teachers?
Novice is at the "survival" stage
User is at the "mastery" stage
Integrator is at the "impact" stage
Facilitator is at the "innovation" stage

The Novice
Struggles against technology of any kind
Has little familiarity with equipment
Is just developing basic technology skills
Is constantly assailed by problems
Cannot anticipate problems
Has unrealistic expectations
Classroom is still teacher-directed
Experiences chaos with technology

The User
Focuses on personal development
Has increased technical competence
Develops coping strategies
Has increased levels of tolerance

Discovers new forms of interaction
Is more engaged with technology
Has increased experience and confidence with new classroom structure

The Integrator
Focuses on student learning
Is less threatened by technology
Uses technology as a content teaching tool
Develops new working relationships and structure
Classrooms are learner centered
Uses technology as a cross-curricular tool

The Facilitator
Becomes a facilitator of learning
Restructures the curriculum and learning activities
Assists others to become users of technology instruction

Make a Comparison
Using technology for instruction
Teaching about technology
Integrating technology into instruction
Teaching with technology

Levels of Technology Use in the Classroom

Nonuse	Integration (routine)
Awareness	Expansion
Exploration	Refinement
Infusion	
Integration (mechanical)	

How to Know if Your Technology Is Integrated
It's a seamless component of the lesson
It advances a lesson-relevant goal
It's a logical extension of the lesson
It's being used to solve a problem
It benefits individual students
It would be hard to teach without it
Its purpose can be easily explained
All students are able to participate
Students are enthusiastic about learning

How To Identify Levels Of Technology Use In The Classroom

This guide can be used to assess where your staff members are in their implementation of educational technologies. These guidelines can be used to evaluate the success of your staff development activities and help to identify the direction of continuing staff development activities.

Nonuse   A perceived lack of access to technology-based tools or lack of time to pursue electronic technology implementation. Existing technology is predominately text-based (e.g. ditto sheets, chalkboard, overhead projector).

Awareness The use of computers is generally one step removed from the classroom teacher (e.g., it occurs in integrated learning system labs, special computer-based pull out programs, computer literacy classes, and central word processing labs). Computer-based applications have little or no relevance to the individual teacher's instructional program.

Exploration Technology-based tools serve as a supplement (e.g., tutorials, educational games, simulations) to the existing instructional program. The electronic technology is employed either for extension activities or for enrichment of the instructional program.

Infusion   Technology-based tools, including databases, spreadsheets, graphing packages, probes, calculators, multimedia applications, desktop publishing, and telecommunications augment selected instructional events (e.g., science kit experiments using spreadsheets or graphs to analyze results, telecommunications activities involving data sharing among schools).

Integration (mechanical) Technology-based tools are mechanically integrated, providing a rich context for students understanding of the pertinent curriculum content concepts, themes, and processes. Heavy reliance is placed on prepackaged materials and sequential charts that aid the teacher in the daily operation of the instructional curriculum. Technology (e.g., multimedia, telecommunications, databases, spreadsheets, word processing) is perceived as a tool to identify and solve authentic problems relating to an overall theme or concept.

Integration (routine)   Teachers can readily create integrated units with little intervention from outside resources. Technology-based tools are easily and routinely integrated, providing a rich context for students' understanding of the pertinent curriculum content concepts, themes, and processes. Technology (e.g., multimedia, telecommunications, databases, spreadsheets, word processing) is perceived as a tool to identify and solve authentic problems relating to an overall theme/concept.

Expansion Technology access is extended beyond the classroom. Classroom teachers actively elicit technology applications and networking from business enterprises, governmental agencies (e.g., contacting NASA to establish a link to an orbiting space shuttle through the Internet), research institutions, and universities to expand student experiences directed at problem solving, resolving issues, and student activism surrounding a major theme or concept.

Refinement   Technology is perceived as a process, product (e.g., invention, patent, new software design), and tool for students to use in solving problems related to a real-world issue. In this context, technology provides a seamless medium for information queries, problem solving, and product development. Students have ready access to and a complete understanding of a vast array of technology-based tools to accomplish any particular task.

Adapted from C. Moertsch (1998), Computer Efficiency, **Learning and Leading with Technology**, p. 53

Guidelines for the Integration of Technology into Content Areas

The Curry Center for Technology and Teacher Education, in association with a number of content-based professional associations is developing technology guidelines for the integrating of technology into the content areas. Eventually, these guidelines will be adopted and used to guide teachers and administrators in the best way to integrate technology as a strong component in the education of students. Guidelines are being developed for English, math, science, and social studies. The guidelines for math and science are included here as examples to aid in the understanding of proper integration of technology into the core curricular areas. Review the Web page for the Center for Technology and Teacher Education to follow the development of these guidelines (http://teach.virginia.edu/teacherlink/).

Technology Guidelines for Math Education (Draft)
We are currently preparing guidelines that reflect what we believe to be appropriate uses of technology in mathematics teaching. Many of our activities follow the guidelines below, as applicable:
>*Introduce technology in context*
>*Address worthwhile mathematics with appropriate pedagogy*
>*Take advantage of technology*
>*Apply mathematics topics*
>*Incorporate multiple representations*

Introduce technology in context
>Features of technology, whether mathematics-specific or more generic, should be introduced and illustrated in the context of meaningful content-based activities. Teaching technology or software-based skills and then trying to find mathematical topics for which they might be useful, is comparable to teaching mathematical skills and using the procedures to solve a collection of "word problems." Such an approach can obscure the purpose of learning and using technology, make mathematics appear as an afterthought, and lead to contrived activities. The use of technology in mathematics teaching is not for the purpose of teaching about technology, but for the purpose of enhancing mathematics teaching and learning with technology. Furthermore, in our experience teachers who learn about technology while using it to explore mathematics topics are more likely to see its potential benefits and use it in their classrooms. This guideline is in accord with the first recommendation of the President's

Committee of Advisors on Science and Technology, Panel on Educational Technology (1997): "Focus on learning *with* technology, not *about* technology" (p. 7).

Address worthwhile mathematics with appropriate pedagogy

Content-based activities using technology should address worthwhile mathematics concepts, procedures and strategies, and should reflect the nature and spirit of mathematics. Activities should support sound mathematical curricular goals and should not be developed merely because technology makes them possible. Indeed, the use of technology in mathematics teaching should support and facilitate conceptual development, exploration, reasoning, and problem solving, as described by the National Council of Teachers of Mathematics (NCTM, 1989; 1991). We believe technology should not be used to carry out procedures without appropriate mathematical and technological understanding (e.g., inserting rote formulas into spreadsheets), nor should it be used in ways that can distract from the underlying mathematics (e.g., adding too many bells and whistles in a PowerPoint presentation). In other words, mathematical content should not be compromised.

Another way to prevent technology use from compromising mathematics is to encourage users to connect their experiential findings to more formal aspects of mathematics. For example, students using software to explore geometric shapes and relationships should use previously proven theorems to validate their empirical results or should use their results to propose new theorems. Mathematical notions of "proof " and "rigor" need to be addressed as well. Technology should not influence students to become what Schoenfeld (1985) refers to as "naive empiricists." This guideline is in accord with the second recommendation of the President's Committee of Advisors on Science and Technology, Panel on Educational Technology: "Emphasize content and pedagogy, and not just hardware" (p. 7).

Take advantage of technology

Activities should take advantage of the capabilities of technology, and hence should extend or significantly enhance what could be done without technology. Technology enables users to explore topics in more depth (e.g., interconnect mathematics topics, write programs, devise multiple proofs and solutions) and in more interactive ways (e.g., simulations, manipulating, probes). Technology also makes possible the study of new topics that were previously impractical by removing computational constraints (e.g., recursion, regression, fractals). Using technology to teach the same mathematical topics, in fundamentally the same ways that could be taught without technology, does not strengthen students' learning of mathematics and belies the usefulness of technology. Furthermore, using technology to perform tasks that are just as easily or even better carried out without technology may actually hinder learning. Such uses of technology may convince teachers and administrators that preparing teachers to use technology is not worth the considerable effort and expense necessary to do so.

Connect mathematics topics

Technology-augmented activities should interconnect mathematics topics and connect mathematics to real-world phenomena. Many school mathematics topics can be used to model and resolve situations arising in the physical, biological, environmental, social, and managerial sciences. Many topics can be connected to the arts and humanities as well. Appropriate use of technology can facilitate such applications by providing ready access to real data and information, by making the application of mathematics topics more practical, and by making it

easier for teachers and students to bring together multiple representations of mathematics topics. This guideline supports the curriculum standards of the NCTM (1989).

Incorporate multiple representations

Activities should incorporate multiple representations of mathematical topics. Research shows that many students have difficulty connecting the verbal, graphical, numerical, and algebraic representations of mathematical functions Goldenberg, 1988: Leinhardt, Zaslavsky and Stein, 1990). Appropriate use of technology can be effective in helping students make such connections. For example, connecting tabulated data to graphs and curves of best fit, generating sequences and series numerically, algebraically, and geometrically.

Contact: Joe Garofalo (jg2e@virginia.edu)

Technology Guidelines for Science Education (Draft)

The Curry School of Education is working with the Association for the Education of Teachers in Science to devise guidelines to shape the development of activities and materials for pre-service and in-service science teacher education. These guidelines reflect what we believe to be appropriate uses of technology in science teaching, and include the following:

Introduce technology in context
Address worthwhile science with appropriate pedagogy
Take advantage of technology
Promote relevancy
Make scientific views more accessible
Promote scientific inquiry
Promote student-centered learning
Develop understanding of technology and its relationship to science

Introduce Technology in Context

Features of technology, whether science-specific or more generic, should be introduced and illustrated in the context of meaningful content-based activities. Teaching technology or software-based skills and then trying to find scientific topics for which they might be useful, can obscure the purpose of learning and using technology, make science appear as an afterthought, and lead to contrived activities. The use of technology in science teaching is not for the purpose of teaching about technology, but for the purpose of enhancing science teaching and learning. Furthermore, teachers who learn about technology while using it to explore science topics are more likely to see its potential benefits and use it in their classrooms. This guideline is in accord with the first recommendation of the 1997 President's Committee of Advisors on Science and Technology, Panel on Educational Technology: "Focus on learning with technology, not about technology."

Address Worthwhile Science with Appropriate Pedagogy

Content-based activities using technology should address worthwhile science concepts and process skills as well as reflect the nature of science. Activities should support sound scientific curricular goals and should not be developed merely because technology makes them possible. Indeed, the use of technology in science teaching should support and facilitate conceptual development, process skills, and habits of mind that make up scientific literacy, as described by the National Science Education Standards and Project 2061. We believe technology should not be used to carry out procedures without appropriate mathematical and technological understanding (e.g., inserting rote formulas into spreadsheets), nor should it be used in ways that can distract from the underlying science (e.g., adding too many bells and whistles in a PowerPoint presentation). In other words, scientific content should not be compromised. Another way to prevent technology use from compromising science is to encourage users to connect their experiential findings to more formal aspects of science. For example, students might use graphing calculators or spreadsheets to derive formula from empirical data. Technology should help students to develop beyond what Schoenfeld refers to as "naive empiricists," and should encourage them to view scientific knowledge as evolving and socially constructed. This guideline is in accord with the second recommendation of the President's Committee of Advisors on Science and Technology, Panel on Educational Technology: "Emphasize content and pedagogy, and not just hardware."

Take Advantage of Technology

Activities should take advantage of the capabilities of technology and should extend beyond or significantly enhance what could be done without technology. Technology enables users to explore topics in more depth (e.g., enhance observations, integrate mathematics and science, and derive scientific formula from empirical data) and in more interactive ways (e.g., simulations, manipulating, probes). Technology also makes it practical for students to collect data useful to scientists, such as global climate data and positional data for celestial bodies and events.

Care should be taken that students understand the nature of technologies being employed and that the technologies do not confuse the science being taught. For instance, students must understand the processes of coding and layering of data in ArcView to appreciate the scientific meaning in ArcView graphics. In taking advantage of the real-time graphing capabilities using probe ware and computers, researchers have found that students must be taught how to interpret graphs.

Using technology to teach the same scientific topics, in fundamentally the same ways, that could be taught without technology does not strengthen students' learning of science and belies the usefulness of technology. Furthermore, using technology to perform tasks that are just as easily or even better achieved without technology may actually be a hindrance to learning. Such uses of technology may convince teachers and administrators that preparing teachers to use technology is not worth the considerable effort and expense involved.
.

Promote Relevancy

Technology-augmented activities should connect students experience with science to their own experiences. Graphing the motion of a student walking in real time, helps the student in other fields analytically express common experience. Choppy walking motions toward and away from a motion detector are later connected to a scientific understanding of velocity. Numerous school science topics can be used to model and solve situations arising in the physical, biological, environmental, social, and managerial sciences. Many topics can be connected to the arts and humanities as well. Appropriate use of technology can facilitate such applications by providing ready access to real data and information and by making the inclusion of relevant scientific topics more practical.

Make Scientific Views More Accessible

Many scientifically accepted ideas are difficult for students to understand due to their complexity, abstract nature, and their relationship to common sense and experience. Appropriate technologies have the potential to make scientific concepts more accessible through visualization, modeling, and multiple representations. For example, the Kinetic Molecular Theory, an abstract set of concepts central to the disciplines of physics and chemistry, may be easier for students to understand if they can see and manipulate models of molecules operating under a variety of conditions.

At the same time, use of technologies must meet the challenge of helping students understand the technology as well as the science. For example, students must not mistake a simulation for the real thing. Sophisticated computer graphics for molecular motion is only a model.

Promote Understanding of Scientific Inquiry

Understanding science as inquiry lies at the heart of the National Science Education Standards. Use of technology should support student understanding of how science approaches the study of the environment. Technology can help students pose questions for scientific study. For instance, the display of earthquake data on a world map can be used to guide students to question why geographic locations form certain patterns. Students can be prompted to design investigations that lead them to seek related data such as occurrences of volcanic activity. Other uses of technology can support conducting investigations and the direct collection and presentation of data. PowerPoint or spreadsheet functions could support presentations that demonstrate the relationship between hypothesis and data. Further manipulations of the display can help students formulate conclusions based on data. For example, by examining graphical formats, students can be guided to think about implications by looking for trends, identifying categories, or making comparisons. Applications of technology should help students share and collaborate in all of the above investigative activities.

Promote Student-Centered Learning

A major goal of learning in science is to develop reflective, independent learning in students. In a complete science education program students learn relevant bodies of knowledge, how to conduct scientific inquiry, and the nature of scientific work. To accomplish this complex task, teachers must promote learning that becomes increasingly student-centered. Technology can promote the development of skills that help students become more independent learners. The Internet offers a variety of knowledge sources requiring students to learn skills of evaluation and reflection. Using the Internet as an example, students are provided opportunities establishing criteria for selecting information and continuous reflection on the purpose and direction of learning. Integrated word processing, graphics, and presentation software create learning environments that promote development of cognitive skills for summarizing, synthesizing, and critical thinking. Electronic communications foster creative collaborations among distant locations and motivate students to seek advice and input from other students. Judicious use of technologies help students become the managers of their own learning environments that stretch from school to home to sites around the world.

Develops Understanding of Technology and its Relationship to Science

Technologies are simultaneously tools for learning about science and examples of the application of technology to solve human problems. In the latter context, students learn that technologies come with risks and benefits. Efficiencies of storing and retrieving of information come with the risks of losing large quantities of data in damaged disks, system malfunctions, or incorrect actions on the part of users. Uses of technology for learning science can emphasize how technologies produce trade-offs, for instance, between gaining more sources of knowledge through Internet and CD's while at the same time creating a greater expenditure of time and effort at sorting information that is appropriate and of high quality.

Using technologies in learning science also provide opportunities for understanding the reciprocal relationship between science and technology. Extrapolating from technology applications in classrooms, students can appreciate how advances in science drive technology where scientific knowledge drives new technologies. Computer modeling of chemical structures leads to the development of new materials with numerous uses. In reciprocal fashion, high-quality computer displays and faster computers make possible scientific work that was impossible before such advances. This leads to new ideas in science.

Contact Randy Bell (rlb6f@virginia.edu)

References:
Goldenberg, E.P. (1988). Mathematics, metaphors, and human factors: Mathematical, technical, and pedagogical challenges in the educational use of graphical representations. *Journal of Mathematical Behavior*, 7, 135-173.
Leinhardt, G., Zaslavsky, O., and Stein, M.K. (1990). Functions, graphs, and graphing: Tasks, learning and teaching. *Review of Educational Research*, 60(1), 1-64.

National Council of Teachers of Mathematics (1989). *Curriculum and evaluation standards for school mathematics*. Reston, VA: NCTM

National Council of Teachers of Mathematics (1991). *Professional standards for teaching mathematics*. Reston, VA: NCTM.

President's Committee of Advisors on Science and Technology, Panel on Educational Technology (1997). *Report to the President on the use of technology to strengthen K-12 education in the United States*.

Schoenfeld, A. (1985). *Mathematical problem solving*. New York: Academic Press.

Behaviors and Indicators That Can Provide Evidence Of Technology Integration In The Classroom

Teacher Indicators:

Technology utilization is evident in lesson plans.

Curricular goals are attained through the use of technology.

Computer activities show a natural application and logical connection and extension of the curriculum.

Continuous learning, enthusiasm, and interest in technology are exhibited.

System is in place for answering students' questions while using computers.

Learning objectives for computer activities are clear.

Logical classroom management processes are in place to facilitate a "user friendly" environment.

A variety of software including database, spreadsheet, telecommunications, and multimedia applications are utilized.

The learning environment is student-centered and interactive. Learning activities include both collaborative and cooperative projects.

Student Indicators:

Students can explain the "what" and "why" of their work at the computer.

Students collaborate and work in teams to solve problems.

Students are enthusiastic and motivated about technology.

Students demonstrate inquiry and discovery learning.

Students have basic computer skills appropriate for the selected learning activity.

Students are focused on the station at which they are working.

Students understand the classroom procedures for computer utilization.

Classroom Indicators:

Room arrangement is conducive to group and learning stations.

Student rotation assignments are posted.

Student work on display indicates technology utilization.

Supplies are organized and accessible.

Lab Indicators:
        Allow for whole group demonstration.
        Supplies are available.
        Clean and organized environment.
        Helpful hints and manuals are available.
        Information is posted showing how technology is used in our world.

Adapted From: Henrico County Public Schools

Resources

Educational Leadership Tool Kit http://www.nsba.org/sbot/toolkit/
Virginia Society for Technology in Education http://www.vste.org/
Virginia's Public Television Stations
http://www.pen.k12.va.us/VDOE/Technology/DOEhour/PTV_REG.htm

Milken Exchange on Educational Technology http://www.milkenexchange.org/

The National Educational Technology Standards (NETS) Project by ISTE http://cnets.iste.org/
Content Knowledge http://www.mcrel.org/standards-benchmarks/index.asp
McREL Educator Resources http://www.mcrel.org/resources/index.asp
EvaluTech – searchable (free) database of evaluations of recommended (North Carolina
Department of Public Instruction, and School Library Journal) books, software, and Web sites
http://www.evalutech.sreb.org
The California Instructional Technology Clearinghouse – evaluations of instructional materials
http://clearinghouse.k12.ca.us/
EPIE Institute's The Educational Software Selector (TESS) Online – evaluation of instructional
materials http://www.nde.state.ne.us/tess/
The Argus Clearing House – a guide to curriculum guides of Web sites
http://www.clearinghouse.net/
Blue Web'n – searchable archives of online instructional Web sites, and E-mail service of
weekly updates http://www.kn.pacbell.com/wired/bluewebn/
Connections + (From Content Knowledge: A Compendium of Standards and Benchmarks For K-
12 Education) – lesson plans, activities, curriculum resources
http://www.mcrel.org/resources/plus/index.asp
Ed's Oasis – links to instructional Web sites and examples of effective classroom use
http://www.edsoasis.org/Oasis.html
Kathy Schrock's Guide for Educators – a classified list of sites for enhancing curriculum,
updated daily http://www.capecod.net/schrockguide/
David Levin's Learning @ Web.Sites - links to Web sites to enhance senior high school
curriculum and instruction http://www.ecnet.net/users/gdlevin/home.html
The Global Schoolhouse – interactive telecommunication projects for students to connect with
other students around the world http://www.gsn.org/index.html

NASA Langley's Learning Technologies Project – teacher lesson plans, student online and hands-on projects correlated with SOL, and information
http://k12unix.larc.nasa.gov/index2.html
The Bridge Teacher Resource Center – a Sea Grant National Ocean Partnership Program, Web links to scientists and research institutions, lesson plan collection, and information centers for ocean science topics http://www.marine-ed.org
MAKING TECHNOLOGY HAPPEN: Best Practices and Policies from Exemplary K-12 Schools For Teachers, Principals, Parents, Policy Makers and Industry, Southern Technology Council http://www.southern.org/makingte.htm
Learning & Leading With Technology (L&L) ISTE http://www.iste.org/L&L/
Parents Educators Publishers - Directory of PEP Resources and Services http://www.microweb.com/pepsite/browse.html